

be associated in any stable manner with volume of investment, and that it is important to determine just what the relationship is.

No reasonable reader could expect Salter to cover everything important that is implied by the words "productivity and technical change." Salter does not ask why technical change occurs the way it does, or what determines the rate of saving, for example. Nor does he deal (except incidentally) with the questions of policy—regarding monopoly, capital markets, money, taxes, tariffs, patent laws, agriculture—that concern everyone who asks how economic growth may be accelerated. Salter's is a scientific work—an intelligent and workmanlike piece of scientific work—of the kind needed to put solid ground under policy to stimulate growth.

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Pro and Contra Darlington

The Sounds of Language. An inquiry into the role of genetic factors in the development of sound systems. L. F. Brosnahan. Heffner, Cambridge, England, 1961. 250 pp. 25s.

Brosnahan writes well. He has a wide knowledge of linguistic, psychological, and genetic facts and the gift of clear presentation. He is fair in his presentation of other theories and modest in the claims he makes for his own. Nevertheless, I remain unconvinced of any solidity in his fundamental thesis: that inborn factors have an appreciable role in predisposing populations toward developing given types of sounds. The idea is that of the geneticist, C. D. Darlington; Brosnahan attempts to support it as a linguist.

As the author states it, the problem is "why any community of speakers should select, and indeed should be continually selecting certain articulations in preference to others" (page 7). His answer is that over long periods of time there is a tendency to move toward the sounds which are easier to produce and that these are different for each human group, depending on hereditary physiology. The matter seems to be exaggerated. The structure of the mouth and throat and the capacity to hear sounds are sufficiently developed in all humans, with rare

individual and no racial exceptions, to handle all sounds used in all the languages of the world. The minor differences can hardly explain the phonetic changes which have occurred in languages. For example, what could have happened to the mouths of the forerunners of the historic Greeks to cause them to change *s* to *h*? Whatever caused this, why did it subsequently permit the Attic Greeks to bring into use new instances of *s* as a replacement for *t* before the vowel *i*? And what did the ancient pre-Greeks have in common with other human groups in scattered parts of the world, which at one time or another made the same transformation of the sibilant?

To carry conviction for this thesis, Brosnahan would have to show sound changes in relation to specific physiological characteristics of the speaking organs, but he deals rather with blood factors. Thus, he presents an apparent correlation between the geographic distribution of the O-factor in the blood and the development of dental fricatives (*th*-sounds) in Europe. Since the blood does not directly participate in the production of sounds, one would have to find some indirect link between the two facts, and this link need not be physiological as such. The development was certainly related to the movement and the influence of Germanic peoples and languages and to the effect upon these of contact with Slavic and other groups. Thus phonetics and blood show a correlation only because both reflect the distribution, movement, and mixing of historic peoples and not for any causal relation between genes and speech sounds.

A few considerations can be mentioned to support the explanation which I have given here and which is opposed to that of Darlington and Brosnahan. First of all, it should be emphasized that the correlation claimed by Darlington and Brosnahan is positive but not closely so. Furthermore, there are evidently other linguistic features with a more or less similar correlation to O-blood in Europe, for example the use of the definite and indefinite articles in Germanic and neighboring languages and the absence of these articles in Slavic and other Eastern languages. Obviously differences in the patterns of word combination cannot be explained by genes, and especially not by the same genes as those supposed to account for phonetic differences. And finally, the changes discussed by Brosnahan are found in

other parts of the world, where there is no connection with O-blood.

In only one place does Brosnahan seem to deal with phonetic changes that may be physiologically induced, and that is when he speaks of Chatterji's observation of a tendency toward the fronting of sounds during recent millennia. Conceivably this is related to change tendencies which occurred during the skull's development from long-headedness to round-headedness, changes which were accompanied by reduction of the length of the palate, thereby giving less contrast to the position of back and front consonants; this could favor the elimination of certain phonetic contrasts, which would then need to be replaced by new ones. Yet, even here, the evidence is far from unmistakable. Perhaps the capacity to distinguish sounds has advanced along with changes in the cranium. At any rate there are round-headed populations whose language differentiates more front-back sound types than other, long-headed ones. Any firm conclusion on an interrelationship will have to be based on much careful study.

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Structure Analysis

X-Ray Analysis of Organic Structures.

S. C. Nyburg, Academic Press, New York, 1961. xii + 434 pp. Illus. \$13.

Organic chemists and biochemists who wish to deepen their understanding of the techniques of x-ray structure analysis and the results of its application to organic systems will find here a book tuned to their needs. The author's aim is to provide a foundation, "with the minimum of formal mathematics . . .," on the basis of which the reader will be able "to assess the reliability of the published results [and] appreciate fully the powers and limitations of the method."

The book is divided into two main parts. In the first, comprising a little over one-third of the book, the x-ray diffraction method of structural analysis is developed. The discussion ranges from experimental techniques (chapter 1) through crystal and molecular symmetry (chapters 2 and 3) to Fourier analysis (chapter 5) and the problems of accuracy of structure determinations