to find a post in some physiological laboratory in the U. S. I do not know English well enough to give lectures just at present but in one to one and one half years I would be able to do so. But now I think I could be of use in some research institution.

I have a similar request to make to you on behalf of my friend Privat Docent A. A. Kronforsky, lecturer on pathology and bacteriology at the University of Kieff, whom I can recommend most warmly. He would emigrate to America for the purpose of continuing his scientific work.

Please be so kind to direct your reply (if it is possible cable me) to British Consulat General in Odessa for Professor B. P. Babkin, Physiological Laboratory, University of Odessa.

With kind regards,

Yours sincerely,
B. BABKIN

QUOTATIONS

RESEARCH AND THE UNIVERSITIES

"IMITATION research" is the latest object of attack by the Carnegie Foundation for the Advancement of Teaching. "Much," declares the report "of that which has gone on in American universities under the name of research is in truth only an imitation." This is a strong statement. Most persons familiar with the facts, it is safe to say, will feel that it should be modified by striking out "much" and substituting "some." A favorite game with critics of university work has long been the quotation of subjects of doctoral theses. Even those who should know better are unable to resist the temptation of provoking a laugh at the expense of the scholar who labored to give to the world the boon of several hundred pages on "The Middle English Ideal of Personal Beauty," or "A Study of the Cogmonina of Soldiers in the Roman Legion," or "Plane Nets with Equal Invariants." The Carnegie report does not descend to this level, but it gives aid and comfort to such criticism by coupling its extreme statement about "imitation research" with advice to the universities "to take stock of themselves before appealing to the public for funds on an enormous scale."

That stock taking has already been done, and by an agency as pitiless as this world knows. The direction of our war effort was committed in large measure to the college-trained man. He was, in many important positions, a person cursed with a Ph.D., the stigma that told of seminars and laboratories and—well, research. He came from everywhere, from the fresh-water institution of limited facilities as well as from the university of unrivalled resources. That he "made good" from the beginning is one of the commonplaces of the history of our war. He took hold of a situation as unacademic as the most skeptical of his critics could have imagined, and proceeded as if the war were nothing more baffling than a particularly unruly set of sophomores.

There was not a little running around in circles at Washington during the months following April, 1917, but the specialist, product of the American research methods, did not indulge in it.

The colleges are far from perfect. Many worthless law schools are doing a large business, as Dr. Pritchett's report observes, and it it to be hoped that the Foundation may be as successful in wiping them off the map as it has been with the same brand of medical school. But the public has never appreciated research work at its true value, and the rather sensational language of the report is likely to do more harm than good. We need more research work and not less—more of the kind actually prevailing in the mass of our universities.—*The New York Evening Post.*

SCIENTIFIC BOOKS

Inbreeding and Outbreeding, Their Genetic and Sociological Significance. By EDWARD M. EAST AND DONALD F. JONES. Philadelphia and London, J. B. Lippincott Co., 1919. Pp. 285. 46 illustrations.

No better example than this book affords is likely to be found of the successful carrying out of the purpose of the series of "Monographs on Experimental Biology," which is stated by the general editors in these words: "Biology which not long ago was purely descriptive and speculative, has begun to adopt the methods of the exact sciences, recognizing

that for permanent progress not only experiments are required but that the experiments should be of a quantitative character. It will be the purpose of this series of monographs to emphasize and further as much as possible this development of Biology." Until quite recently discussions of inbreeding, whether by biologists or others, have savored of anything but the "methods of the exact sciences." It is safe to say that no phase of biology has been enveloped in such a fog of superstition, old wives tales, and other sorts of misapprehension as has inbreeding. The investigations of East during the past decade and more have been a potent and pioneer influence in dissipating this fog. It is particularly appropriate that he and his former student Jones should prepare a critical general review of the really scientific work which has been done in this field. It is a service which puts all biologists considerably in their debt.

After an introductory chapter which defines the problem of inbreeding and shows its relation to practical questions of sociology and agriculture, as well as biology, three chapters are devoted to the statement of some elementary biological facts and principles which are essential to any rational discussion of a problem which involves and arises out of the phenomena of reproduction on the one hand, and of heredity on the other hand. These chapters, as would be expected by any one acquainted with the authors' other writings, are models of clear and condensed exposition. Chapter V. deals with "Mathematical Considerations of Inbreeding" in which is reviewed recent work on the measurement of the degree of inbreeding existent in complex pedigrees, and on the gametic consequences which must follow the continued inbreeding of a Mendelian population. The analysis of the latter point shows that the amount or degree of heterozygosity decreases with continued inbreeding. The authors state the expectations in the following words:

> Assuming, then, that the loss of the stimulation accompanying heterozygosity is correlated with the reduction in the number of heterozygous factors, we should expect to find the decrease of heterosis greatest in the first generations, rapidly becoming less until no further loss is noticeable in any number of subsequent generations of self-fertilization, and that on the average the decrease will become negligible from the seventh to the twelfth generation and from then on no further marked change will take place. Segregation of characters and appearance of new types and reduction in variability will also follow the same course. Some cases are to be expected in which stability is reached earlier, and some cases in which it is reached later; or, theoretically it may never be reached.

The next chapter reviews the actual results of long continued inbreeding. The classic data here are afforded, on the animal side, by Miss King's brilliant experiments with the white rat, and on the plant side by the no less outstanding work of East and Jones on maize, corroborated by the concordant but less extensive researches of Shull on the same form. These two great experimental investigations may fairly be regarded as a real triumph of American biology. Operating in a field on which a mass of inconclusive experimentation and uncritical speculation had been carried out these researches of East, Shull and Miss King have essentially *solved* for all time the important features of the problem of inbreeding. We now understand where formerly we speculated. The main aspects of the problem are now matters of exposition not debate. The net result must be stated in the authors' words:

> In tracing the evolution of ideas concerning the effects of inbreeding and outbreeding we must give great credit to Darwin for calling attention to the importance of the phenomena in relation to evolution and for being the first to see that heredity differences, rather than the mere act of crossing, was the real point involved; but with all due credit to Darwin, it was not until Mendelism became known, appreciated, and applied that the first real attack upon the problem was made possible. When linked with Mendelian phenomena it was clearly recognized for the first time that one and the same principle was involved in the effects of inbreeding and the directly opposite effects of outbreeding. Inbreeding was not a process of continual degeneration. Injurious effects, if present, were due to the segregation of characters. In addition to this segregation of characters the fact was established

that an increased growth accompanied the heterozygous condition. All the essential facts were accounted for. A decade later the great extension of knowledge in the field of heredity has made possible a still closer linking of the facts of imbreeding and outbreeding with Mendelism. The hypothesis of the complementary action of dominant factors is the logical outgrowth of former views and makes the increased growth of hybrids somewhat more understandable. The fact of a stimulation accompanying heterozygosity is supplemented by a reason why such an effect is obtained. The former view of a physiological stimulation and the more recent conception of the combined action of dominant factors are not then two unrelated hypotheses to be held up for the choosing of the one from the other. The outstanding feature of the latter view is that there is no longer any question as to whether or not inbreeding as a process in itself is injurious. Homozygosity, when obtained with the combination of all the most favorable characters, is the most effective condition for the purpose of growth and reproduction.

A chapter on the value of inbreeding and outbreeding in plant and animal improvement gives a very sane and well-balanced discussion of the practical application in agriculture of the principles set forth in the earlier portion of the work. So far as thoroughly scientific exposition may hope to do so the bogey of the necessary and inevitable harmfulness of inbreeding is laid to rest. It is pointed out that, so far as may be judged from the past, inbreeding has been the greatest single instrument in the breeder's hands for securing uniformity and the concentration of desirable qualities. It has the further advantage of bringing clearly to light undesirable qualities which may then be easily eliminated by selection or otherwise.

The last two chapters of the book are of a more speculative character, but surely no one will deny to those who have made such solid experimental deposits in the bank of knowledge the right to speculate a bit. The first of these chapters deals with effects upon the individual and the second with effects upon the race. Both chapters may fairly be regarded as among the sanest and most cogent arguments for the integral incorporation of eugenic ideas and ideals into the conduct of the social and political affairs of life which have yet been put forth. The known facts are examined critically, though briefly, and there is a refreshing absence of blind and blatant propaganda. To take a single simple example it is shown with great clearness that the ridding of a racial germ-plasm of defective characters is very far from being the simple process that enthusiastic devotees of sterilization legislation would have us believe. To prevent the multiplication of individuals visibly bearing the defects is, in theory at least, not particularly difficult. But to do this alone will not even approximately solve the problem. The residual and vastly more difficult question concerns the somatically normal transmitters of defective qualities.

Altogether this is a notable book, in which American science may well take pride. It should form a part of the required reading of every student of biology, because nowhere else is there brought together in such clear and well-digested form the results of a mass of experimental work which has successfully lighted a dark corner of biological science.

RAYMOND PEARL

SPECIAL ARTICLES

CORRESPONDENCE BETWEEN CHROMOSOME NUMBER AND LINKAGE GROUPS IN DROSOPHILA VIRILIS

A STUDY of twenty-seven mutant characters[1] in *Drosophila virilis* Sturtevant, reveals the presence of at least five groups of linked genes in this species—in contrast to the four groups in *Drosophila melanogaster* (*ampelophila*). This difference in number of linkage groups agrees in a significant manner with the difference in number of chromosomes in the two species. *D. melanogaster,* as is well known, has four pairs of chromosomes—three large and one very small—and correspondingly has three large groups and one small group of linked genes. *D. virilis,* on the other hand, has six pairs of chromosomes—five large and one

[1] Descriptions of some of these have appeared in two earlier papers: Metz, C. W., *Genetics,* 1: 591–607, November, 1916, and Metz, C. W., *ibid.,* 3: 107–134, March, 1918.