side, with results of extraordinary interest, not only to entomologists, but to all biologists. In the earlier days Weismann and Merrifield, in later times such men as Standfuss of Zurich and Morgan of New York, have produced works of such value as to arrest the attention of all naturalists. In particular, Morgan's intensive study of the vinegar-fly, *Drosophila*, has given us a knowledge of the facts of variation and heredity which the most optimistic would have declared impossible a few years ago. Thus all doubt as to the value of minute and detailed investigation of single genera and species has been dispelled, except in the minds of those who take no interest in the biological problems of the day. Indeed, it must be said that any able student who will study a single small group or species from *all points of view*, will be sure to get results of value and importance, whereas as a collector of miscellanea he may go through life without making any significant contribution to science. Thus the new outlook and the new methods open up a great new field for amateurs, who may readily make themselves more familiar than any one else with a special small field of research, knowing at the same time that their discoveries will have some bearing on the whole structure of biological science.

We approach the subject of variation to-day with many advantages not enjoyed by our predecessors. Owing to the rediscovery of Mendel's work, and the great advances in our knowledge of cytology and of the processes of heredity, we are able to interpret what we find with better success. We no longer content ourselves with describing, in objective terms, the phases of variation found, but undertake to classify them according to their true dynamic significance.

Variation may arise from different causes, as follows:

1. Original variation, due to some change in the character of the germ plasm itself. Theoretically, this may come about either through (a) the addition of something, or (b) the subtraction of something, or (c) the redistribution of what was already there, following the phenomena already well known to students of organic chemistry. Tower, of Chicago, appears to have produced variations of this sort in potato-beetles (*Leptinotarsa*), but it is possible to interpret them as the result of selective destruction of elements (genes) in the germ plasm, which is, at least theoretically, a different matter from altering the genes (factors determining characters) themselves. The sudden appearance of red on the rays of a sunflower in Colorado can be interpreted as due to a doubling-up or duplication of a gene for red which is undoubtedly present in the normal wild plant.

   Furthermore, when a variation occurs in a gamete (unfertilized germ cell) which is recessive to the normal,—that is, fails to produce any effect when united with a normal gamete,—it may be an indefinite time, possibly a thousand years, before there will be any visible result. A visible result will only appear when two individuals, each carrying the modified character, chance to mate. Thus when we witness what appears to be an entirely new "break," we may be observing the consequences of a chemical change which occurred long ago, the causes of which, whatever they were, have long ceased to operate.

   The most important evidence has been obtained by Professor Morgan and his associates in their studies of *Drosophila*. In numerous cases new variations have arisen under circumstances which seem to