because the languages of primitive man are disappearing rapidly, thus depriving us of valuable material for comparative study.

Ethnology, the last division of anthropology, covers a vast field. Its main object may be briefly described as the discovery of the laws governing the activities of the human mind, and also the reconstruction of the history of human culture and civilization. The methods applied by ethnologists are twofold. The investigation of the history of the culture of definite areas is carried on by means of geographical and of archæological methods. The methods are geographical in so far as the types inhabiting a country, their languages and their customs, are compared to those of neighboring tribes. They are archæological in so far as they deal with the prehistoric remains found in the country in question. In this case we apply inductive methods for the solution of historical questions. The investigation of the laws governing the growth of human culture is carried out by means of comparative methods, and is based on the results of the historical analysis referred to before. These laws are largely of a psychological nature. Their great value for the study of the human mind lies in the fact that the forms of thought which are the subject of investigation have grown up entirely outside of the conditions whice govern our own thoughts. They furnish, therefore, material for a truly comparative psychology. The results of the study of comparative linguistics form an important portion of this material, because the forms of thought find their clearest expressions in the forms of language.

It appears, from these brief statements of the scope and methods of anthropological research, that an acquaintance with the whole field is indispensable for the sociologist; that a knowledge of results and methods will be of advantage to the psychologist, and that the statistical method developed in physical anthropology will be very helpful to the student of biology. In a general way, a knowledge of the outlines of anthropology seems to be of educational value, particularly in so far as it broadens the historical views of the student, because it extends his view over cultures and civilizations that have grown up uninfluenced by our own. The advances made by our own race will appear to him in a truer light when he is able to compare them with the work done by other races, and if he understands how much our own civilization owes to the achievements of people who appear to be at present on a low level of culture. The methodological value of the teaching of anthropology lies in the fact that it shows the possibility of applying inductive methods to the study of social phenomena.

Franz Boas.

BOTANY.

There are some phases of botanical teaching that do not belong in the present discussion. University teaching, where selected, well-trained, devoted students pursue original investigation under the criticism and advice of great specialists, is excluded, for there is here no question of methods, but only of men. It represents the ideal relation of teacher to student, the true ideal for all botanical teaching. We have in this country some, but far too little of it. Again, college work proper, consisting in advanced thorough courses upon the practicum plan and in the investigation spirit, hardly belongs here. Such work has been stimulated by university example to a high degree of excellence, and in botany much of it is being done to-day in our colleges, a fact with an important bearing upon our present subject, for thus are being trained the teachers of the near future who are to elevate the teaching of the schools. But in the teaching of systematic elementary courses in botany, where these are not

under the direct control of teachers educated thoroughly and in the modern spirit, that is, in the elementary courses in many of the smaller colleges and in most high schools, there are questions and problems enough. Just here lies the center of discussion, effort and advance in methods of botanical teaching at the present time. Below the high schools, in primary and grammar grades, where systematic courses in the sciences are wisely not attempted, but a foundation is laid for them in continuous and thorough courses of 'Nature Study,' there are problems, too, but of a simpler sort, whose solution will follow upon the solution of those of the high school. Just as university teaching has elevated college teaching, both through example and through training teachers for it, just as in the same manner it is college teaching today that is elevating high-school teaching, so in the future will good high-school teaching improve that of the lower grades.

In describing the quality of most elementary botanical teaching I would not call it bad, but simply insufficient. It is not true that it commonly teaches error, or is useless as training, but it is true that it is far behind and unrepresentative of the present state of the science. This backwardness is illustrated in many ways, of which I shall mention but two. First, it is, as a study, low in public opinion, good public opinion, which regards it as synonymous with the study of the names of flowers, and hence as a discipline peculiarly fitted to the minds of school girls, or as an appropriate hobby for elderly persons of leisure. Second, it has stood low in the estimation of many university and college authorities, as shown by their frequent neglect to provide for its proper teaching, while amply providing for the sister science zoology, and some of the leading universities have not considered it as of particular value as an element in training in biology. It must be confessed that these opinions are in the main just. Botany, as taught, has been too much the study of the names of flowers, and it has had very little to contribute of value for biological training. The reason for this backwardness is plain enough and most instructive—it is the result of an almost exclusive cultivation of a single phase of the science, entailing an abortion of other phases and an inability of the whole to respond elastically to the science as it broadens. This one phase has been classification of the higher plants, a phase determined by the overpowering influence of Dr. Gray, who for two generations towered so far above all other leaders of botany in America as to set his work as the standard, both for investigators and teachers. Systematic work involves an extreme attention to terminology and a concentration upon the statical aspects of plant structure. In the hands of poorly trained or overworked teachers it has run much to the filling-out of blanks, collection of herbaria and memorizing of lists of terms, thus becoming educationally little better than a system of mnemonics, or the working-out of mechanical puzzles. This sort of thing is not necessarily bad, but it is woefully uneconomical, one-sided, and neglectful of those other phases of the science that are attractive, useful and illuminating as knowledge, and rich in breadth and sympathy as training.

But these conditions have recently begun to change, and to-day are improving with a rapidity not realized outside of a few centers. The movement is with the expanding science, especially towards the study of the plant alive and in action. Its best evidence is to be found in the most recent elementary text-books, of which a large number, of increasing excellence, have appeared in the past two or three years. A comparison of the works, but a few weeks old, of Barnes or of Atkinson, with the best works of five years ago will show how rapid,

how great and in what direction the change is. Chief of the several causes of the advance is this: University and college teachers, imbued with the newer and broader spirit, are taking an interest in the elementary teaching of their subject not only in their own colleges, but also in the schools. If we consider the elementary text-books of approved standing and widest use in this country that have appeared within the past three years, those by Spalding, Bergen, Strasburger, Vines, Setchell, Curtis, L. H. Bailey, Barnes and Atkinson, we find that with but one exception, they are by university or college teachers. It is, of course, but presumption for any college teacher to attempt to instruct a school teacher in methods of imparting knowledge to school children; but the college teacher, with his broader horizon, larger command of the sources of knowledge, and better facilities for experiment, can best set forth what the science has to offer to education, and the most useful proportioning and treatment of topics. The new school teacher can be trusted to take care of his own methods. This is the spirit of the newer books; they do not seek to impose any system upon teacher or student, but are storehouses of knowledge and advice to be drawn upon by all according to their needs.

We turn next to a summary of advances actually being made in elementary botanical teaching, and of tendencies likely to be of importance in the near future. I need hardly speak of the continuous spread of laboratory and decline of rote instruction; happily this is now a matter of course. Aside from this, the first and greatest of current advances is the shifting of the point of view from the static to the dynamic side of the plant, entailing a great increase of attention to physiology and ecology. We are ceasing to look upon the plant as, first of all, a *structure* to whose parts certain functions attach, and are beginning to see it as a living thing whose functions determine its structure, a working, struggling organism, plastic, though with an hereditary stiffness, to outside influences, not striving to realize some ideal plan, but simply to fit itself to the conditions that exist. Thus the leaf, from one point of view a structure of such a shape, size, venation, cellular composition, etc., carrying on the work of photosynthesis, is from another a mechanism so built as to expose a large amount of green tissue to light and to protect, support, supply and aerate it, and any given leaf is a resultant of the working of all these factors upon it, and as any one of them varies with the external influences so does the leaf vary. Now the clue to this view of the leaf lies in the necessity for light in the formation of starch, the food and sole source of energy of the plant, and this can be appreciated by a student only after experiment upon the relation of light to starch formation, experiment that happily is very easy and everywhere practicable. Thus approached, leaf-structure becomes luminous. In the same way it is absorption of liquids by osmosis that explains the root, and the resultant between the physical requirements of this osmosis and the varying external conditions under which roots are forced to grow, explains why a given root is the form, size and texture it is. Again, it is observation of modes of locomotion of pollen in effecting cross-fertilization, and secondary conditions connected therewith that explain the flower, and so on. Experience is showing that the only road to an objective understanding of anatomy and morphology lies through physiology and ecology. And this conception of the plant, as a living, working, struggling, plastic being is not only the truest, the most objective conception of it, but is, as well, the one that excites the greatest human sympathy and interest, and, therefore, is in itself the best 'method' the science has to offer.

It is sometimes objected that practical difficulties in thus teaching the science are too great to be overcome, for teachers are untrained, experiment is difficult and appliances are expensive. All this is in great measure true, but rapidly coming to be less so, and no one expects, nor is it desirable, that changes should come too rapidly. Many colleges are now training teachers in this knowledge and spirit, and simpler, less expensive and more logically conclusive experiments for demonstrating the fundamental principles of physiology are being invented. There is, however, one difficulty which must be admitted to be very real, namely, the present unorganized state of ecology. At present this division of the science is little better than a series of huge guesses; very little really conclusive work has been done in it, and no distinct methods of ecological experiment nor principles of ecological evidence have been formulated. Just here lies one of the most attractive fields open to botanists to-day, one whose returns will be of priceless value to botanical teaching.

A second advance is towards a more natural morphology. Next after classification the phase of botany most taught in elementary courses is morphology. But morphology as taught in our schools is dominated by a rigid formalism based on the idealistic system introduced into botany by Goethe, a system easy to teach and one that appeals to a certain stage of culture in both race and individual, but one objectively untrue, and one that, if allowed to dominate and direct morphological conceptions, is actually pernicious and sterilizing. It is only through an approach to structure from its statical or systematic side that one can be satisfied with the conception of plant morphology which views the higher plant as a combination of elements so immutable as to retain their nature through the most extreme changes and combinations, even to the point of being present when invisible, that can find carpel and calyx in all inferior ovaries, can homologize the parts of a stamen with the parts of a green leaf, or ovules with something on the leafy shoot. From this formalism the newer books have broken away; their morphology conforms to the observed facts of plant development, which show adaptation not to a plan, but to conditions as they have existed.

Among minor advances may be mentioned a wider use of the inductive investigating spirit showing itself in the growing custom of placing new matter before the student in the form of problems so arranged that their solution comes just within the scope of his own powers. Another is a greater flexibility in laboratory methods. The day of published laboratory guides to be put into the hands of students is, I believe, passing; they will be replaced by outlines made by the teacher for each exercise to fit his particular mode of instruction and the material in hand. There is greater nicety and exactness, too, in the laboratory work; the 'rough sketch' is less heard of, and drawings whatever else they may be, must be diagrammatically accurate. Another is a better proportioning of laboratory and text-book work. There is a reaction from the tendency to make laboratory work everything and to scorn the text-book, and the latter, for supplementary reading after the laboratory work, is again in favor, and it is for this purpose the newer and better books are written. All of these advances and tendencies are most healthful and in the line of real advance.

I shall close this subject by pointing out three marked tendencies, not of botany alone, but of education in general, which, in my opinion, are most rich in promise for the advancement of botanical teaching, and which, therefore, all botanists should unite to promote. The first is the tendency to pay less attention to methods and more to

men; to obtain better material for the making of teachers; to educate them thoroughly in the spirit and matter of some one subject or limited group of subjects, and to leave them free to develop their own methods, judging them only by their results. This is what the universities have done with such signal success, what the colleges are now doing and what the schools must do if they are to advance. It is not methods that teach, but men and women. The second is toward the establishment of thorough and continuous courses in Nature Study through all grades from the kindergarten to the high school. There are two reasons for this from our present point of view. Thus only can students acquire a knowledge of the more obvious facts and phenomena of Animal and Plant life, Physical Geography, Physics and Chemistry so valuable as a basis for the systematic study of some one of the sciences in the high school. But, far more important than this is the use of Nature Study to preserve the natural inductive facilities of children unimpaired through school life, not to speak of improving these facuties through training. No fact about our later and better courses of elementary botanical study is more striking than the unanimity with which they begin with exercises adapted to train observation, comparison, etc.—in a word, induction. Now, these are powers that children possess naturally, the most universal of human faculties, those by which new knowledge is won; those by which self-made men succeed; those which surely above everything education ought to cherish and develop. But, as a matter of fact, these faculties somewhere between the primary and high school are so effectually throttled out of nine-tenths of our students that the first need of the high-school or college teacher is to redevelop them. This suppression is, of course, the result of excessive text-book and deductive work, which always tends to make students distrustful of their own powers and leads them to regard as the only real sources of knowledge the thoughts of others properly recorded in printed books. Thorough and properly taught Nature Study is, in my opinion, the first need in all education to-day.

Third of the tendencies I have mentioned is this: The movement among the colleges to require, or at least accept, some one thoroughly-taught science for entrance, amongst which botany is always included. This will compel preparatory schools to improve their teaching, for the science offered must be enough in quantity and quality to allow students to omit the elementary course in the college and enter upon second courses. Moreover, this movement will allow college teachers to exert more influence than ever upon school teaching, for, controlling admission, they can state which topics are to be studied and what general methods are to be followed. A great part of the value to botanical teaching of this movement will, however, be lost, unless, in the very near future, the colleges, through their proper representatives, agree upon approximately-equivalent requirements, so that the preparatory schools may not be distracted and weakened by widely-differing demands.

Though botanists are thus eagerly striving to promote the interests of their science, it is not their desire unduly to magnify its importance, but only to give it its proper place in education and among the sciences. Their aim, I believe, may be thus expressed: Let education advance; let science advance; let botany advance.

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ELEVENTH ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA, DECEMBER 28TH, 29TH AND 30TH, NEW YORK.

I.

The Geological Society of America completed the first year of its second decade with