publications going to its members and read by a wide public are forces making for appreciation of the value of science to society and the need of giving adequate support to scientific research and to scientific men. Each member of the association contributes to this end and does his part to improve the situation for others as well as for himself. It is consequently to be hoped that no one will permit his membership to lapse on account of the necessary increase in nominal dues, but, on the contrary, that every member use all possible efforts to increase the membership of the association and to promote its influence and its usefulness.—*The Scientific Monthly.*

SCIENTIFIC BOOKS

The System of the Sciences; Principles of the Theory of Education. By Wilhelm Ostwald. The Rice Institute Pamphlet, Vol. II., No. 3, Nov., 1915.

These two lectures were prepared to be given at the inauguration of Rice Institute but the author was prevented from delivering them in person by the outbreak of the Great War. The purpose of the lectures is ambitious, being no less than to propose a fundamental system or classification for the branches of science and, on the basis of this system, to suggest a system of pedagogy which should replace, in some measure, our present system. The subjects now taught, in our universities, in particular, have grown up in an irregular, hit-or-miss fashion, especially as regards the introduction of new subjects, because "Wherever there is a gifted representative of a new discipline who is an excellent teacher and at the same time scientifically productive, he will be able sooner or later to acquire the means and influence to develop this new discipline into a recognized science." Professor Ostwald wishes to substitute for this accidental development a rational, systematic cultivation of those fields which will be most useful—presumably, though he avoids saying so directly, with the repression and discouragement of the gifted individual who does not properly fall into the scheme which has been laid down. This is scarcely in accord with that "Lehrfreiheit" of which the older Germany was so proud.

The historical method is used, in part, to discover the proper system. "All sciences in the early stages of their development formed one great whole, which, together with all other departments of human activity having to do with mental work and cogitation, was intrusted to the oversight of a single corporation—the priesthood." And so the theological faculty is the oldest—then came law—he might have said, perhaps, the Roman Law, for our modern world—and medicine. All the remaining sciences are united in the fourth, the philosophical faculty. The great technical schools form, practically, a fifth faculty, which is not, however, recognized as such.

The statement on p. 112 that "the pure and abstract sciences grow by degrees out of the applied sciences" seems scarcely consistent with the beginnings of the higher forms of knowledge in the hands of the priesthood. Nor does it agree with the development of science through such great masters as Gallileo, Newton, Boyle and Lavoisier. Applied sciences made very slow progress until men came who were interested to know the secrets of nature rather than to apply their knowledge to practical ends. The same idea is emphasized again on p. 121 in the statement that "all sciences have had their origin in the needs and desires of life." This is a utilitarian point of view which we are scarcely prepared to accept.

The over-emphasis on classical and linguistic studies is traced back to the time of the Renaissance when such studies opened to the world a wealth of material from an old and superior, but half-forgotten civilization. At such a time the exact knowledge of the languages which should bring back the old life and philosophies of the Greeks and Romans was well worth while. But now that we have developed a different and very much better civilization of our own the time devoted to classical studies can not be so well justified. It is possible, however, that the author under-

estimates the value of those linguistic studies pursued in his youth that gave to him a power to use language clearly and forcibly which it would have been difficult to acquire in any other way.

In the further discussion of language it is pointed out that the content of words which have grown up in the usual manner, through long use, is often vague. This and other considerations lead the author to advocate the use of an artificial, general language with accurately defined words. Such a point of view overlooks the fact that many of the words of our mother tongue carry in themselves delicate shades of meaning which represent our memory of their use in a great variety of connections. Such words can not be successfully replaced by words of a foreign tongue, still less by the words of an artificial language.

In classifying the sciences the simplest and most general ideas came first. These embrace logic or *relationships,* mathematics, or numbers, order, form and quantity, and the science of time, for which there is no distinctive name. The second division, *energetical sciences.* includes mechanics, physics and chemistry. These use the concepts and principles of the first division while the sciences of the first division are, in an important sense, independent of either of the others. The third division, the *biological sciences,* is divided into physiology, psychology and "culturology."

Thus far the divisions of human knowledge and the pedagogical sequences based upon them may be accepted as useful and there is very much of sound common sense in the discussion. But very many will object to the complete omission of any direct reference to moral and religious education, and to his treatment of the child as merely an "energetical machine" (p. 202). On p. 120 the author says; "We shall renounce in any scientific system the consideration of all supernatural relationships of whatever nature, and, on the other hand, we shall extend our scientific problems to each and every field of human experience." If by "supernatural relationships" is meant some one who interferes occasionally and irregularly and capriciously in human affairs, the large majority of scientific men will agree. But if Professor Ostwald means that there is no "Power not ourselves which makes for righteousness" many of the leaders both in England and in America will dissent most strongly. In remembrance of the bitter controversies of the past, we are wont to be very silent about questions of this kind, but to very many it is simply unthinkable that the orderly universe in which we find ourselves is merely the blind resultant of the interaction of matter and energy without some intelligence which is in and through it all.

Somewhat related to his philosophy is Professor Ostwald's statement (p. 206) of "the most general problem of every human life" as "the attainment of happiness." He recalls his former conclusion that "the most important requisites for happiness are, first, the greatest possible amount of completely transformable free energy, and, secondly, the greatest possible amount of energy transformed voluntarily." It is very interesting to notice the naïveté of the last phrase. Anything done "voluntarily" is either a self-deception or it is in flat contradiction with a materialistic or mechanistic philosophy. But there is no mechanistic philosopher who does not act as though he considers himself, practically, a free agent.

The definition of the conditions of happiness is incomplete in a still more important respect. It overlooks the fact that in matters of happiness "he that saveth his life shall lose it." Happiness is not found best by seeking it *directly.* We condemn and despise the man who makes his own personal happiness or even the personal advantage of his family the supreme object of his life. The great men of the world have risen far above such considerations. The time is coming when the class, or community or nation which considers its own advantage as paramount to that of all others will also be condemned. Indeed, the execration which Germany has brought upon herself from the whole world was chiefly due

to her supreme national selfishness. Unfortunately, some of the nations which have condemned her so unsparingly are not free from the same fault.

As so often happens, Professor Ostwald is very much better in his conduct as a man than his philosophy might lead us to expect. In these days of international bitterness and hatred, it is worth while to recall an incident of the St. Louis Congress of Arts and Sciences. Professor van't Hoff gave an address in which he presented a masterful sketch of the historical development of chemistry, especially from the point of view of the atomic and molecular theories. In the course of the address he wrote on the blackboard the names of some of the great leaders in chemistry—such names as Dalton, Dulong and Petit, Pasteur, La Bel, Guldberg and Waage, Curie and others. At the close of the address Professor Bancroft, who was in the chair, called on Professor Ostwald. Those were the days when Ostwald and some others wished to find some way to get on without the atomic theory. He began his talk with a very kindly criticism of the address in which he proposed to substitute "energy" for "atoms" and suggested that at the hands of the Curies atoms had "exploded." Then he picked up a piece of chalk and saying "I have still another correction to make" he wrote in the name of van't Hoff at three different places among the great names on the board and in each case those who were present recognized instantly that van't Hoff, in three widely separated fields, had done work of the same fundamental and far-reaching importance as the work of the other men. It is the kindly, generous spirit shown in this incident which endeared Professor Ostwald to his students and to many others with whom he came in personal contact.

The suggestions with regard to students helping each other with their tasks are novel and striking. "It is considered at present one of the worst offenses for one child to help another solve its task. *Is, then, mutual willingness to help a characteristic so exceedingly general that it must be systematically done away with in school?* Is not, rather, egoism and narrowmindedness a fault under which we suffer severely? I do not hesitate to express the conviction that a considerable amount of this illiberality is imparted to our growing youth in school by the prevalent notions regarding this mutual help and the usual treatment of it." So far, good, and worthy of consideration in our treatment of children and of students. But the corollary is not so good—"others learn at an early age that in their advancement they have need of the assistance of better endowed ones, and, what is the best thing for all of them, they learn subordination and how to work in rank and file"—a picture of a world where some are born to rule and others to be ruled. How different from the democratic ideal, where these same differences still exist and always will exist, but where men should work together, not as superior and subordinate, but each according to his ability, for the common good.

We can not take the space for a more detailed criticism of the addresses. While the author of this review dissents most earnestly from a part of the philosophy which lies at the foundation of the papers, there is very much in them which is sound and worthy of most careful study.

William A. Noyes

SPECIAL ARTICLES

DROUGHT AND THE ROOT-SYSTEM OF EUCALYPTUS

In the fall of 1913 the eucalyptus trees, especially the *Eucalyptus globulus* in the Arboretum of Stanford University, were evidently dying. Various persons questioned the members of the Department of Botany here as to the reason for the grave appearance of these large trees and none of us was able to give an answer satisfying to himself. For this reason we undertook to determine the cause of the trouble.

By permission of the business office we tapped various trees with an auger to the heart and found that the wood and bark were entirely free from disease of any sort. The