Recognizing the wisdom of this course, the International Committee of Weights and Measures, in October, 1880, resolved that in its publications and in its official use the term *litre* should be used to express the volume of a kilogramme of pure water at maximum density. The one-thousandth part of this, that is to say, the volume of a gramme of pure water at maximum density is called the *millimetre*, and the abbreviation *ml.* is used to stand for it.

The *litre* and the *millilitre*, therefore, are not precisely identical with the cubic decimetre and the cubic centimetre. The difference, however, is very small, and may safely be neglected in all ordinary operations. Where a high degree of accuracy is required, it will usually be found that the results are primarily obtained by the mass-density method, and that no correction is required.

The International Bureau is engaged in an elaborate investigation of the relations of mass, volume, and density in pure water, and, when the results are available, they will doubtless satisfy the most exacting demands. T. C. MENDENHALL.

Washington, D.C., April 14.

On the Teaching of Biology.

IF the article "On the Emergence of a Sham Biology in America," by Mr. Conway MacMillan, printed in *Science* for April 7th, 1893, had appeared in a special journal, it would not be worth while to notice it, but since *Science* reaches many people who are not specialists in any branch of biology, it may not be a waste of time to point out some of its special merits.

The author of the article looks over the courses offered in biology in some of the leading universities of the country, and, finding that botany does not receive adequate treatment, he apparently becomes fired with the serious purpose of exposing what he illogically calls a "sham" science.

The Johns Hopkins University, which has done as much as, if not more than, any other single institution in the country, for the advancement of biological science in America, during the last seventeen years, is stigmatized in a way which will highly amuse those who are acquainted with its work. This institution is accused of dishonesty in naming its zoölogical courses. "Injustice," "wrecker-light use of the word 'biology,'" "protective mimicry in a university curriculum," "perpetrating a confidence game upon a board of trustees," are some of the choice phrases which are indulged in. These flattering remarks are not limited to the institution; they extend even to its graduates. "The cool effrontery of this would have surprised me had I not known the marvellous, sometimes continuous, sometimes sporadic, always insular capabilities of the Johns Hopkins biologist for blatant philistinism in regard to things botanical."

Of course it is not necessary to take such criticism as this seriously. The tone of the article is so thoroughly bad, and the looseness of statement so completely inconsistent with anything bordering on scientific accuracy, that sober criticism is well nigh impossible.

The chief merit of the paper lies in pointing out the great value which a good course in general biology, such as that given for many years at the Johns Hopkins University, may possess for an average student, who will follow it with a fair degree of fidelity. Such a student would have learned what Lamarck, Treviranus, and Bichat comprehended, and what Huxley and the school of biologists who have been inspired by his teaching have striven with signal success to inculcate,— that the study of biology is not, as this erratic writer supposes, two disciplines, but *one discipline*, the study of living phenomena, in which the distinction between plant and animal, in the widest sense, is one of secondary importance.

A student who had followed this general biological course with a fair degree of success would have learned that "biological science is *not* to be set over against physical science in the broadest sense," but that in this broadest sense biology is a physical science, coördinate with chemistry and physics. In biology there is no natural cleavage into two branches, botany and zoölogy, any more than there is a natural constriction of chemistry into the studies of minerals and the compounds of carbon, because the plane of division in either case would be a purely imaginary one. An appreciation of this truth does not conflict with the obvious fact that biologists in general find it convenient to specialize either in the direction of the study of plants or the study of animals. Biology is often primarily divided, for convenience, into study of living structure and study of function, or into morphology and physiology, because the study of living structure is one subordinate discipline, and the study of function is another. For further convenience we may further classify these sub-sciences, according to their subject-matter, into vegetable morphology and animal morphology on the one hand, and into vegetable and animal physiology on the other.

Let an institution that sets about to teach biology do all it can to put before its students the principal facts of morphology and physiology of both plants and animals, but to pronounce its work, if well done, a "sham," through its inability to cover the whole field, is, to say the least, a very flagrant misuse of language. The title of Mr. MacMillan's article is misleading, and the whole tone of it is characterized by this glaring misuse of words. He does not distinguish between a "sham" science and a science too much "restricted" or "narrowed." Even if we grant the most that is said in regard to the teaching of biology at some of the institutions named, all that would be proved would be that the science of biology had been too much restricted at these places, not that there was any element of "sham" in it. The work which the Johns Hopkins University has done for the study of biology in this country proves conclusively that there has been no element of "sham" in its methods.

I find in the Johns Hopkins University Circulars for March, 1893, No. 104, eleven courses offered to students in the biological department, including seminaries and clubs. One course is announced in "Cryptogamic Botany"; the rest have reference almost exclusively to animal physiology and morphology. An elementary course in botany has been given at this university for years, and lecture courses in vegetable morphology and physiology of a more technical nature have been offered from time to time, showing that the study of plants is far from being ignored. The biological work of this university, as is well known, has been chiefly devoted to the study of animal physiology and morphology, and the work that it has undertaken it has done eminently well. Nothing could be more unjust than any inference that this university has encouraged its students to undervalue the study of plants. On the contrary, it has regretted that it has had no fully equipped botanical laboratory to offer its students, and it has uniformly advised them to go to institutions better equipped in this department for the special study of plants.

It is not possible for every institution to take the same color with reference to the special lines of scientific investigation, but this is a different thing from saying that it is not desirable for every institution to have a well-balanced curriculum. In most of the smaller colleges the man at the head of his department is the only teacher in it, and if he is a botanist his work will soon take on a botanical tinge; if morphologist or physiologist, his special work is sure to come to the front. This explains a good deal of the "sham" element that Mr. MacMillan has discovered in American biological teaching.

The stimulus which comes from the association of specialists in a large educational centre is undoubtedly very helpful, but as soon as students commence to leave the elementary stages of their work, and to enter upon special lines of investigation, their sympathies immediately diverge with increasing rapidity. It is therefore desirable that this loss of sympathy on the part of one specialist for the work of another, should be postponed as long as possible. One means of accomplishing this in a large university, in the case of biology for instance, is undoubtedly to present the whole subject in the fullest manner, especially in the elementary courses.

There is no doubt that every biologist, whatever the special line of work to which he devotes himself, should have the same training up to the point of specialization, in at least chemistry, physics, morphology, and physiology. The attitude of mind which Mr. MacMillan displays comes from a lack of this early compre-

hensive training, or at least from the lack of profiting by it. If while himself a student at the John Hopkins University, he had determined to get all there was in the admirable elementary courses which are there offered in general biography, zoölogy, animal physiology and embryology, instead of interesting himself from the first mainly in plants, he would not only have been enabled to take a broader view of his specialty, but would not have committed himself to the position in which this article places him.

Mr. MacMillan incidentally remarks that he has "not at present time to discuss the fundamental absurdity of courses in 'general biology,' as if it were possible to plunge boldly into comparative study of plants and animals before one has studied plants and animals themselves. It is as if one should enter upon analytical statics and follow it up by geometry and the calculus." Here again Mr. MacMillan demonstrates the urgent need of a good course in general biology for botanists as well as for zoölogists. Here the analogy drawn is false. Zoölogy and botany do not bear a similar relation to biology that geometry and the calculus bear to the higher mathematics. The instruments for solving problems in botany and zoölogy are essentially the same, such as good observation, sound reasoning, a knowledge of technical methods, and of the other physical sciences.

It is not necessary for the student to examine a large number of organisms in order to come face to face with the fundamental properties of living things, and this fact proves that Huxley and his successors are right in insisting that the study of biology is one discipline. To teach the student this, and to lead him to discover some of the wider agreements and differences of living organisms, is of more intellectual value to him than to conduct him at the start to the more special study of either plants or animals. This is true whether he is to become a specialist in biology or not.

Some of the chief merits of Mr. MacMillan's paper have now been pointed out. A subordinate merit which it possesses is that of calling attention to the defect in many institutions of not including botany in their curriculum, or in not giving it the prominence which it deserves. If he had limited himself to pointing out this defect, without casting slurs upon honored institutions and their graduates, in an offensive way, his article might have done good.

FRANCIS H. HERRICK.

Adelbert College, Cleveland, Ohio, April 15th, 1893.

A New Source of the So-Called Mexican Onyx.

LOVERS of the beautiful, in the way of high-grade material for decorative work, will be pleased to learn of the recent discovery, on the peninsula of Lower California, of extensive deposits of the so-called Mexican onyx. The new find is some 150 miles southeast of San Diego, and 50 miles from the Pacific coast. The material, as is the case with that of Mexico proper and other sources, is a travertine (i.e., a spring deposit) and not stalagmitic. The deposits are essentially superficial, the material in many instances so occurring as to be taken directly from the surface of the ground by means of bars and without previous stripping. The colors are light green, rose, and white, variously veined and tinted, and of great beauty, while in compactness of texture, susceptibility to polish and freedom from flaws, the material leaves little to be desired. A company has already been organized for working the deposits, and the first shipment has reached St. Louis, to be cut and polished for exhibition at Chicago during the World's Columbian Exhibition.

GEORGE P. MERRILL.

Washington, D.C.

BOOK-REVIEWS.

The Metaspermæ of the Minnesota Valley. A list of the higher seed-producing plants indigenous to the drainage basin of the Minnesota River. By CONWAY MACMILLAN. Minneapolis, 1892. 839 pp. 2 Maps. 8°.

BOTANISTS will examine this volume with interest, because of the numerous new features it presents. It is the first of the botanical reports of the Geological and Natural History Survey of Minnesota, and, while entirely local in its character, it is very far beyond the usual local catalogue. It contains a record of 1,174 species and varieties, distributed among 407 genera and 106 families. Under each family reference is made to the place of its original characterization, the number of genera and species, living or extinct, it contains, and its distribution in a very general way. Under each genus we have the synonomy as fully as may be, again with a reference to the number of species and their more detailed distribution. Finally, under each species and variety the synonomy is given, still more detailed distribution, and mention of herbaria where specimens are to be found. It will thus be seen that, while it is a catalogue of plants, it is one in a wider sense than the majority of such publications. Its interest and value to botanists lie not alone in the various facts above referred to, but because it discards the time-honored arrangement of orders, such as is found in the ordinary manuals and text-books, and introduces the newer and more natural system of classification. It contains, besides, a discussion of the factors upon which classification is based, principles of geographical distribution, and extraordinary statistical detail respecting the plants named in the list.

We turn first to the classification and nomenclature. We well recollect when we first began to study botany, the feeling of satisfaction that was felt at the seeming stability of the science. We had been familiar with the discussions of zoölogists and geologists regarding the condition of nomenclature in their respective branches, and the botanical manuals gave no sign of changes that were to come, or indicated the presence of dangerous ground. But rumblings of the coming eruption were soon heard, although it was not until the publication of that amazing book of Kuntze's, "Revisio genera plantarum," which has turned everything upside down and set the whole botanical world by the ears, that the full violence of the eruption was realized. Against many of the suggestions of this reformer there has been open revolt, but upon the whole the effect has been good. It is true it has compelled those who learned their botany some years ago to learn much of it over again, and has made our latest text-books obsolete or old-fashioned, but it has also put the science upon a more stable foundation.

The discussion of generic and specific names has introduced the perennially fertile subject, a natural classification of orders. The plan of placing Ranunculaceæ at the head of Anthophyta and Gramineæ at the foot is so familiar that scarcely any other seems possible. It has been recognized, however, that the system was very faulty, and numerous endeavors have been made to change it. As long ago as 1883 the present writer, in an article entitled "On the Position of the Compositæ and Orchideæ in the Natural System,"[1] pointed out that the old arrangement was far from being the best; and he made some suggestions as to what families should take the highest rank. He suggested that among dicotyledons Compositæ should be regarded as the highest, inasmuch as here is found the largest production of seed (the end of all plant life) with the least expenditure of material, and, at the same time, with ample provision for cross fertilization. The immense number of species and their great range were also cited to prove their high position. The impossibility of arranging the orders in a strictly natural and yet lineal system was recognized, but it was suggested that the Labiatæ were somewhat parallel with the Compositæ in their differentiation; while with that order were associated, as near allies, Verbenaceæ, Borragineæ, and Scrophularinæ. Among polypetalous orders Leguminosæ was placed highest, followed closely by Rosaceæ, Saxifragaceæ, Umbelliferæ, and Ranunculaceæ. Among monocotyledons the Orchideæ were accorded the highest rank, mainly because of their large numbers, wide distribution, varied form, and elaborate means for cross fertilization. At the same time, a general scheme was proposed, which is reproduced here. In it, it will be observed that there are four general lines of descent, viz., from Orchideæ, Liliaceæ, Palmæ, and Gramineæ. The relative rank of the smaller orders is not that which has been followed in the volume under review, but the

[1] American Naturalist, December, 1883. Also read in the Minneapolis meeting of the A. A. A. S.