mendation of the committee above mentioned should not be accepted, for it is opposed to the established rules of priority.

F. W. Clarke

THE CYTOLOGICAL TIME OF MUTATION IN TOBACCO

In the current volume of Science, p. 35, Hayes and Beinhart after describing the origin of a many-leaved variety of Cuban tobacco by mutation say:

> This mutation must have taken place after fertilization, *i. e.*, after the union of the male and female reproductive cells. If the mutation had taken place in either the male or female cell before fertilization, the mutant would have been a first generation hybrid, and would have given a variable progeny the following season.

Is it not equally probable that the mutation occurred in an egg-cell which then developed without fertilization? Parthenogenesis is known to occur in tobacco, and mutation in a growing or immature germ-cell seems inherently more probable than in a fully formed and fertilized one. Perhaps the behavior of the additional mutants obtained in 1913 will throw light on the matter.

W. E. Castle

Bussey Institution,
January 2, 1913

SCIENTIFIC BOOKS

Analytical Mechanics. By Haroutune M. Dadourian, M.A., Ph.D., Instructor of Physics in the Sheffield Scientific School of Yale University. D. Van Nostrand Company. Price $3.00.

In his preface, the author states that his "work is based upon a course of lectures and recitations which the author has given, during the last few years, to the junior class of the Electrical Engineering Department of the Sheffield Scientific School." We expect this book to contain, therefore, several topics of special interest to students of electricity. We find a chapter devoted to "Fields of Force and Newtonian Potential," one to "Periodic Motion," one to "Energy" and one to "Work." But, as the author states, "In order to make the book suitable for the purposes of more than one class of students more special topics are discussed than any one class will probably take up. But these are so arranged as to permit the omission of one or more without breaking the logical continuity of the subject."

The author himself is a physicist, and perhaps he intends this book to be suitable for classes in physics. The book seems to be written from the standpoint of the physicist rather than from the standpoint of the engineer. If this book is intended for the students of civil and mechanical engineering, then it must be said it has no advantage over the number of books already in the field. I doubt if it is even as suitable.

Judging from the recent discussions concerning the teaching of mathematics and mechanics, it seems that the successful book has not yet been written. Possibly the book everybody is looking for must be written on a new plan. To say that an author deviates from the generally acknowledged plan need not be a criticism of his book. Dr. Dadourian makes his volume unique in several ways, but I doubt if it will stand the test.

In the first place, he seems to avoid the graphical treatment. The modern tendency seems to be to emphasize this phase of the subject.

The question of "units" is always a source of contention between the physicist and the engineer. The absolute system of units is certainly the most logical. To the engineer, however, it is not a question of logic, but of adaptability.

Another departure from the usual mode of procedure in modern elementary text-books in mechanics is the extent to which he makes use of "vector addition." The first chapter is devoted to the subject of the "addition and resolution of vectors." On page 10 he gives the analytical expression for the resultant of any number of vectors, and the resolution of a vector into its three rectangular components. This section is made the basis of his whole book so far as the composition and resolution of vector quantities (forces, moments, couples, etc.) are concerned. All he needs to say is,

that a couple (for instance) is a vector and the desired equations follow at once. If economy of space means "economy of thought" then the author has made his book very simple indeed. To prove the equivalence of couples it is only necessary to state: "Two couples are equal when the vectors which represent their torques are equal in magnitude and have the same direction." This follows at once from his definition of a vector.

He states in his preface "that a subject like mechanics should start with a few simple laws and the entire structure of the science should be based upon them. In the present work the following law is made the basis of the entire subject:

"To every action there is an equal and opposite reaction, or, the sum of all the actions to which a body or a part of a body is subject at any instant vanishes." He further states that thus the "fundamental principle of mechanics is put in the form of a single law, which is equivalent to Newton's laws of motion and which has the advantages of the point of view involved in D'Alembert's principle."

Here is a unique departure for an elementary book. Does he mean to say that this law, whatever it may mean, is the only assumption he will make and that Newton's laws of motion as usually given will not be made use of? If he does, he completely fails. On page 16, he introduces the conception of "force" as an "action," and without any hesitation applies vector addition to a system of forces. What is he doing here, but assuming the "parallelogram of forces" in its most general form. On page 102 he assumes that a force is proportional to the accleration produced. This assumes Newton's second law of motion. In fact he makes more assumptions than are usually made in elementary text-books of mechanics.

What about the law itself? The first part of the law is clear. "To every action there is an equal and opposite reaction" is nothing but Newton's third law of motion. The word "or" leads us to think that the second part means the same thing as the first part. On page 15 he states that "The fundamental law of mechanics is known as the law of *action* and *reaction*." He then states Newton's third law and gives the following illustration. "Let us apply this law to the interaction between a book and the hand in which you hold it. Your hand presses upward upon the book in order to keep it from falling, while the book presses downward upon your hand. The law states that the action of your hand equals the reaction of the book and is in the opposite direction. The book reacts upon your hand because the earth attracts it. When your hand and the earth are the only bodies which act upon the book, the action of your hand equals and is opposite to the action of the earth. In other words, the sum of the two actions is nil. Generalizing from this simple illustration, we can put the law into the following form:

"To every action there is an equal and opposite reaction, or the sum of all the actions to which a body or a part of a body is subject at any instant vanishes."

Now does he mean to say that the pressure of the hand on the book and the force of gravity acting on the book are equal because they are action and reaction? If he does he errs. *They are not action and reaction* and *are equal only in case equilibrium exists.* He has said nothing about equilibrium and if he does not mean this then what does he mean?

On page 100 he takes up the subject of "motion of a particle." Here he says that "we must extend the meaning of the term *reaction* so as to include a form of reaction which is known as *kinetic reaction*. In his illustration we see that by *kinetic reaction* he means the so-called *force of inertia*. We also see that he considers kinetic reaction as a real force. To this, serious objections can be raised. The meaning of the second part now becomes clear. It is simply *D'Alembert's Principle*—"The impressed forces together with the reversed effective forces form a system in equilibrium."

I fail to see, however, the advantage of assuming D'Alembert's principle as a fundamental law of mechanics, especially since he finds it necessary, in reality, to assume all of Newton's laws besides. Moreover the law itself

as he states it, and his applications of it, are rather confusing. It would be difficult indeed to put D'Alembert's principle in words so that a student at the beginning of his study of mechanics could grasp its significance. Any attempt would be apt to confuse rather than help the student.

Space will not permit me to go into further detail. To be brief, he seems inclined to introduce new difficulties, and to cover up the old ones. The book is not free from loose reasoning.

E. W. Rettger
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Conservation of Water. By Walter McCulloh, C. E. Addresses delivered in the Chester S. Lyman lecture series, 1912, before the senior class of the Sheffield Scientific School, Yale University. New Haven, Yale University Press; London, Humphrey Milford, Oxford University Press. Cloth, $6\frac{3}{4} \times 9\frac{3}{4}$ in. Pp. x + 99; 39 illustrations. $2. Postage, 15 cents.

At a time when the question of our water resources and a national policy regarding them is becoming a matter of increasing importance this book is very opportune. The lectures printed therein cover the following topics:

The first chapter considers the desirability of proper handling of our water supplies and the questions of legal jurisdiction over them. Then follows a chapter on the economic, hydrographic, topographic and geologic data necessary for an intelligent handling of the problem in any case. The third chapter gives some very interesting information in regard to the water power of the United States, both developed and undeveloped, with some statistics that are hard to collect otherwise. The value of storage reservoirs in connection with power developments is shown. The next chapter treats of water supplies for municipalities and the problems of sanitation and drainage. The last chapter describes in detail the water resources of New York state and the present important developments.

This is not a book for a specialist, already well informed in hydraulics, nor is it well adapted for use as a text-book for students. But for all readers who are interested in water resources and related problems it is a book that can be read with profit. It should be of especial value to the non-technical man who desires a broad understanding of the engineering principles involved.

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Stuttering and Lisping. By E. W. Scripture. New York, The Macmillan Co. 1912. Pp. xiv + 251.

After many years of clinical work and private practise in the treatment of speech defects, Dr. Scripture has here written down many of his observations regarding the causes, symptoms and treatment of stuttering and chronic mispronunciation. As a cause of stuttering a "general anxiety neurosis" is emphasized but the author avoids much elaboration of this topic.

In the chapter on symptoms some etiology is necessarily considered and many interesting kymograph records of respiration, vocal and articulatory movements are reproduced. The method of taking these records is well illustrated by photographs, and their significance is discussed in the text. The treatment outlined is perhaps the most valuable contribution in the book and is systematically referred to the preceding diagnosis. The exercises in voice modulation—a method of treatment largely original with the author—are carefully described. Psychanalysis and suggestion are dealt with briefly.

The second part of the book treats of lisping, as it is of negligent, organic or neurotic origin. The mouth positions for articulating the different vowel and consonant sounds are indicated by diagrams, "palatograms" and photographs. Some valuable methods for inducing the patient to attain the proper positions are given. At the end of the book are fifty pages of exercises to be used in the treatment of both stuttering and lisping.

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