the ground that the behavior of an elastic body, for example, is completely determined after a time t_0 by its state at $t = t_0$. According to this view the discrepancies between theory and observation are due to inadequate experimental facilities for the determination of interior initial conditions. Volterra, on the other hand, contends that just as bodies react upon each other at a distance, so it is possible that tensions and displacements separated by an interval of time may be related. Even if the contention of those who question the philosophical basis of the theory is granted, nevertheless the agreement between experimental results and the elastic theory involving heredity is in itself a justification. It seems clear to Volterra that, in view of the difficulty of determining initial conditions experimentally, and in the absence of other theories agreeing with experiment, the theory of heredity offers the only explanation at present possible of a large class of phenomena. He cites the experiments of Webster and Porter in the theory of sound as a cogent illustration, and his own success in the mathematical solution of problems in the theory of elasticity with heredity must be regarded as a potent argument in favor of his point of view.

G. A. BLISS.

SHORTER NOTICES.

List of Prime Numbers from 1 *to* 10,006,721. By D. N. LEHMER. Washington, D. C., Carnegie Institution of Washington, 1914. xvi+133 pp.

THERE are several reasons why number theorists will welcome most heartily the publication of this volume.

First, it answers with utmost directness the question, arising at almost every stage of number theoretic computation, whether or not a proposed number (under ten millions) is prime. Here the question of absolute accuracy of a table is paramount; the user of such a table has no practical means of checking the accuracy of an entry and if he relies upon an erroneous entry his conclusions will be wholly wrong. It is thus quite different from the case of ordinary tables (those of the values of a continuous function), since it is there only a question of approximation and a grossly erroneous error should be detected by the user of the table. The present table prob-

ably possesses the same high degree of accuracy as Lehmer's Factor Table for the First Ten Millions, published by the Carnegie Institution in 1909,—the accuracy of which was emphasized in the writer's review in the BULLETIN, volume 17 (1910–11), pages 36–38. In fact, the present List of Primes was compiled from that Factor Table with ample safeguards against the introduction of new errors. It is true that the Factor Table tells whether a proposed number under ten millions is prime or not; but the necessity of condensation required the use there of a scheme of entry which demands a little extra time and trouble in locating a proposed number. Hence the primality of a number is much more easily detected by the use of the new table.

In the second place, the present table affords information, more accurate than hitherto obtained, concerning the distribution of primes. The table is so arranged that it tells at once (and without the loss of space) the rank of a given prime, for example, that 17 is the 8th prime. Hence the table tells directly the number of primes less than any proposed limit not exceeding ten millions. In his Introduction the author has tabulated and compared the actual count of primes with the values given by the formulas of Riemann, Tchebycheff, and Legendre, at intervals of fifty thousand up to ten millions. Moreover, he has given an account in simple language of the history of those empirical formulas for the number of primes less than a given limit. Finally, there is a description of the manuscript factor table of Kulik up to a hundred millions.

In the third place, the publication of this convenient and compact table of 133 pages (though of large dimensions) of the primes below ten millions has made it practicable that every worker in the theory of numbers shall have in his kit this most essential tool.

The printing has been done very clearly on paper selected after numerous experiments so as to withstand the ravages of time. And this is appropriate for such a monumental work. Completed after ten years of arduous work on the part of Lehmer and assistants provided by the Carnegie Institution, and printed and published by that Institution, the Factor Table and the List of Primes form truly a great monument both to Lehmer and to the Carnegie Institution.

L. E. DICKSON.