boy Clays. There are, of course, well-defined changes between the lower beds of the Potomac, but such changes are gradual, due to the diminution of old types, accompanied by the increase and introduction of more modern forms, while the flora as a whole presents essential continuity. But in passing to the Amboy Clays the case is wholly different, and a wholesale change occurs whereby few of the older types survive. At the same time a great number of new plants appear, and dicotyledons overwhelmingly predominate. In view of this very striking change in the character of the flora, Professor Fontaine puts the very pertinent question, 'Why give the name Potomac to this Group?'

With respect to the much-debated question of the precise relation which the Lower Potomac bears to the Jurassic on the one hand, and to the Cretaceous on the other, there can be no doubt as to the transitional character of the flora as presented by many of its components, but the real 'question as to the Jurassic or Lower Cretaceous age of the Lower Potomac hinges upon the position of the Wealden formation.' Previous studies of the Lower Potomac plants by Professor Fontaine[9] had led him to express the opinion that they indicated a Lower Cretaceous age agreeing with the Neocomian. This conclusion was based on the strong affinity of its flora with that of the Wealden, it being assumed that the view generally held as to the position of the Wealden is correct, that is, that it is the non-marine equivalent of the Neocomian. In spite of the view held by Professor Marsh, Professor Fontaine finds that there has been no evidence sufficient to cause a change of his former expression of opinion, but, on the contrary, a good many facts have come to light that confirm its correctness.

These studies of the Potomac flora indicate that the Potomac formation had a widespread development on this continent, since it is not only recognized in Virginia and Maryland, but to the south and west it extends to Tlaxiaco in Mexico; while on the north and west it reappears in the Shasta of California, the Lower Cretaceous of Queen Charlotte Islands and in the Kootanie of Montana, British Columbia and Alberta.

[9] U. S. Geol. Surv., Monograph XV., 1889, p. 348.

D. P. PENHALLOW.

MONTREAL,
April 27, 1906.

A Respiration Calorimeter with Appliances for the Direct Determination of Oxygen. By W. O. ATWATER and F. G. BENEDICT, of Wesleyan University. Washington, D. C., The Carnegie Institution of Washington. 1905. 4to, pp. 193, 49 figs.

The apparatus for investigations in human nutrition described in this monograph has been in process of development for about twelve years and in its perfected form may be safely characterized as the most elaborate instrument for physiological research at present in existence. Descriptions of the apparatus in its earlier form, and of the various improvements and modifications introduced from time to time, as well as accounts of investigations carried on with it, have been published by Professors Atwater, Woods, Rosa and Benedict as bulletins of the Office of Experiment Stations of the U. S. Department of Agriculture and also as a memoir of the National Academy of Sciences.

The apparatus as described in the publications just mentioned consisted of a Pettenkofer, or 'open circuit,' respiration apparatus, the chamber of which was so constructed as to serve likewise as a calorimeter. With this instrument very accurate determinations were possible of the income and outgo of carbon, hydrogen, nitrogen, mineral matter and energy in man, but the results were incomplete, inasmuch as no direct determination of the amount of oxygen consumed by the subject could be made. With the aid of a grant from the Carnegie Institution, therefore, the authors undertook a reconstruction of the apparatus with this object in view.

For this purpose they have reverted to the earlier type of respiration apparatus, originated by Regnault & Reiset and often designated as the 'closed circuit' type, in which the air after leaving the chamber of the apparatus is freed from respiratory products, re-

plenished with oxygen and returned to the chamber. This type of respiration apparatus has always been recognized as being the most perfect in theory, but serious practical difficulties have been found in its use, and the more easily manipulated if less perfect Pettenkofer apparatus has been the type most commonly employed. It was a bold attempt, therefore, to reconstruct a complicated apparatus, in a scale sufficient for experiments on man, and the authors are to be congratulated upon their success in devising the first practicable large apparatus of this type.

It is, of course, entirely outside the scope of a review to enter upon even an outline description of the apparatus. A study of the monograph can not fail to impress the reader with two things—the ingenuity displayed in the devising of the various parts of the apparatus and the unusual amount of care which has been devoted to the search for sources of error and the determination of their probable magnitude. In the latter respect the volume affords an instructive example of true scientific accuracy, consisting not in inerrancy, but in a critical estimate of the degree of approximation to the truth. Noteworthy, too, is the very interesting method of computing the results of the respiration experiments by which they are made to a large degree to check each other. Check tests of the accuracy of the apparatus as a calorimeter have been made, in which known amounts of heat were generated in it electrically, and also so-called alcohol check tests, in which known quantities of ethyl alcohol were burned in the apparatus and the evolution of carbon dioxide, water and heat and the consumption of oxygen were compared with the theoretical amounts. The observed results differed from the theory by less than one per cent., thus justifying the claim of the authors that the results approach in accuracy those of the most approved methods of chemical analysis.

The monograph closes with a description of one of the numerous experiments on men which have been made with the apparatus, the experimental periods covering from one to thirteen days, and which have demonstrated its entire practicability. American science is to be congratulated upon the addition to its resources of this exceedingly valuable instrument of research, and the Carnegie Institution has performed a great service in rendering its construction possible.

H. P. Armsby.

Studies in General Physiology. By Jacques Loeb. The Decennial Publications, Second Series, Volume XV. Chicago, The University of Chicago Press. 1905.

These studies present a collection of widely scattered papers of Loeb on subjects of general physiology. The two volumes contain 37 papers, monographs, essays and shorter papers, only 13 of which were previously published in English. The publications cover a period of fourteen years, from 1889 to 1902. Some of these papers were published in pamphlet form and were quite inaccessible. These papers present by no means all the studies which this productive investigator has published during that period; nor are there included in this collection such studies which were published in conjunction with some of his associates and pupils—a fact which the reviewer can only regret. With the exception of two or three short papers, every study in this collection presents a more or less extensive original investigation on some biological subject, invariably bringing to light new facts and new points of view. Although these studies deal with a great variety of diverse subjects, there is one apparent background to them all: it is the aim to discover the physical and chemical causes of living phenomena.

The papers are arranged chronologically: the first of them dates from 1889 and the last was published in 1902. The great variety of subjects treated in these numerous papers might, perhaps, be classified in the following four groups: 'Tropism,' 'Physiological Morphology,' 'The Physiological Effects of Ions' and 'Artificial Parthenogenesis,' intermingled with a few miscellaneous subjects not exactly belonging to any one of these groups. The chronology of these papers helps us to get an insight into the gradual development of the