If the section south of Mt. Diablo is considered as a standard for the Ione of California it would be interesting to see whether the divisions admitted by Dickerson may be recognized elsewhere. The series is at many points, especially in southern Oregon, extremely thick, and might easily include more than one faunal horizon as yet unrecognized.

On the whole the writers are in hearty accord with Mr. Dickerson's results. A most valuable point brought out is the discussion of the depths of the water in which the various beds were deposited. It should be the incentive to further studies of this sort which have been altogether too much neglected.

Ralph Arnold,
Harold Hannibal

SCIENTIFIC BOOKS

Artificial Parthenogenesis and Fertilization. By Jacques Loeb. The University of Chicago Press, Chicago, Ill. 1913. Pp. viii + 306. 39 tables and 86 figures. Price $2.50 net; $2.68 post-paid.

As stated in the preface, "Artificial Parthenogenesis and Fertilization" is in reality the English translation of an earlier work, "Die Chemische Entwicklungserregung des Tierisches Eies," enlarged and brought up to date by incorporation of the recent research in the field of development. The realm of artificial parthenogenesis is not a narrow one, by any means. It involves problems of wide physiological interest, the action of ions on tissues, the natural death of cells, immunity, hybridization and organic oxidation, a process coextensive with life itself. Thus we have chapters devoted not only to the history and methods of artificial parthenogenesis, but on "The Relative Physiological Efficiency of Various Isosmotic Solutions"; "Chemical Constitution and Relative Physiological Efficiency of Acids"; "Condition for Maturation of the Egg"; "Heterogeneous Hybridization"; "Hydrolytic Processes in the Germination of Oil-containing Seeds," etc. The chapters contain a mass of detailed results, chiefly those of the author, obtained by almost continuous experimentation over a period of fifteen years. Each is a model of what the experimental method should be—the observation of certain facts, the formation of provisional hypotheses to explain these observations and, most important of all, the subsequent testing of the hypothesis by experiment. Only in this way can a mass of unrelated details be welded together into a logical whole presentable to the general reader, as well as the special student of the field of development.

The more recent discoveries are naturally of greatest interest. One is impressed in reading Loeb's book, with the great variations in the conditions for development among closely related forms—variation in factors which we should expect to be fundamental and universal. Thus we find that the eggs of *Strongylocentrotus purpuratus* do not develop in neutral sea water, but only in slightly alkaline sea water, whereas the eggs of *Arbacia punctulata* develop not only in neutral, but even in a slightly acid medium. The response of eggs to different methods of artificial parthenogenesis varies greatly. All gradations occur from species which are normally parthenogenetic or occasionally parthenogenetic through those ready to respond to any method, even mechanical agitation, to forms developing only after very special treatment or not responding to stimulation of any kind.

A similar variation exists in regard to the oxidative process, which is of particular interest for the theory of development. The rate of oxidation in sea-urchin eggs increases sixfold after sperm fertilization or artificial fertilization. Apparently the sea-urchin egg has come to a rest because something inhibits its oxidations and the sperm can set them going again, with consequent development. With this hypothesis in mind we turn to the starfish egg, only to find that here the oxidations do not increase after the sperm has entered. The starfish egg undergoes a certain amount of development, maturation, in sea water and then comes to rest. The entrance of sperm or treatment of some

kind is then required to continue development despite the fact that the oxidations are going on to their fullest extent. That it is their fullest extent is indicated by the interesting fact that even complete cytolysis of an egg by saponin will not further accelerate its rate of oxidation.

Loeb analyzes the effect of the sperm in initiating development into two factors—first, the sperm contains a lysin, not readily diffusible into the egg of the same species, but readily so into eggs of other species, which produces a surface cytolysis. The surface cytolysis leads to membrane formation in eggs which form fertilization membranes as part of their normal development. Foreign cells and foreign fluids may contain similar "lysins," but eggs are immune to lysins of cells of the same species because they are impermeable to them. Hence they must be carried in by actual penetration of the spermatozoon. In most eggs, especially sea urchins, a second substance must also be carried into the egg to prevent the destructive effect caused by superficial cytolysis. Some eggs, *Asterina, Polynoë* and *Thalassema,* do not require the second corrective factor, due possibly to the fact, as Loeb suggests, that they already contain it or automatically form it. Again we note variability in an apparently fundamental point. The effect of the lysin is imitated by the various membrane-forming substances which if too concentrated lead to complete cytolysis of the egg. The effect of the second substance is imitated by the various correcting agencies, hypertonic sea water, low temperature or a prevention of oxidations by KCN and chloral hydrate.

The lysin, the membrane-forming substance, is the essential in causing development. How does it act? At present only suggestions can be made. A possible method and a very simple one would be the removal of some substance which prevents development. This view which has been suggested and discussed by Loeb and other authors seems the most probable one to-day. The problem of fertilization becomes as much a question of what causes the egg cell to cease development in a certain stage as of the cause for its further development by the entrance of a spermatozoon. In physiological terms we may say that the stoppage of development appears to be due to an inhibiting substance, that it is an auto-narcosis. The lysin in the sperm or any artificial method of causing development, even the prick of a needle, allows the inhibiting substance, the narcotic, to pass out. This result is possibly obtained, although Loeb does not definitely uphold this view, through increase in permeability of the egg. As already mentioned oxidations are not diminished in the resting condition of the starfish egg and it is interesting to note, as shown by Loeb, that oxidations in artificially narcotized cells are likewise not diminished. Narcosis is not due to asphyxiation but is probably due to decreased permeability. Certainly research along the line of cell permeability, especially functionally conditioned changes in permeability is the most promising field for a solution of the problem of development, as of many other biological processes.

The reader interested in developmental mechanics will be well repaid by a close study of Loeb's book. Here is collected in condensed and readable form the results of many years' study together with conclusions and ingenious hypotheses which stimulate to additional discoveries along these and other lines.

E. NEWTON HARVEY

PRINCETON, N. J.

Rocky Mountain Flowers: An illustrated guide for Plant-lovers and Plant-users: with twenty-five plates in color, and twenty-two plates in black and white. By FREDERICK EDWARD CLEMENTS, Ph.D., Head of the Department of Botany in the University of Minnesota, and State Botanist; Director of the Pikes Peak Alpine Laboratory, and EDITH SCHWARTZ CLEMENTS, Ph.D., Instructor in Botany in the University of Minnesota and in the Pikes Peak Alpine Laboratory. The H. W. Wilson Company, White Plains, N. Y., and New York City, 1914. Octavo, 392 pp. ($3.00.)