some may be of very ancient date. Wells are so rare in ancient camps on the downs that ponds were probably the chief source of water supply. Why straw was first used, and how it was first used, are likely to remain unanswered satisfactorily. A description is given of a small experimental pond which the author made. The foundations were composed of wood-wool resting on a chalk base, followed by straw and wooden planks, with puddled clay thereon. Further investigations are promised, and no doubt the success or otherwise of the pond will form the subject of a future paper.

In the discussion which followed the reading of the paper, Dr. H. R. Mill claimed that rain is the principal factor in filling the downland ponds, and suggested that the reason why the lowland ponds the more quickly dry up may be that they are not so carefully made watertight as those on the higher ground.

ARTIFICIAL PARTHENOGENESIS.[1]

THE development of biology into an experimental science is nowhere better illustrated than in the important researches on artificial parthenogenesis which we owe largely to Jacques Loeb, and biologists will welcome heartily the little book in which this distinguished author gives an account of the subject. Prof. Loeb informs us that the object of his investigations was to transfer the problem of the fertilisation (Entwicklungserregung) of the animal egg from the domain of morphology to that of physical chemistry. He recalls the fact that it is only about sixty years since it was first firmly established that the animal egg—with the exception of a few cases—can only develop into an embryo after fertilisation by the entrance of a spermatozoon. Various interpretations have been placed upon this process. O. Hertwig maintained that the essential feature of fertilisation was the union of the male and female pronuclei in the egg-cell, and the observation of this union was undoubtedly of the greatest importance, especially from the point of view of the theory of heredity, but it gave us no real insight into the nature of the stimulus which evokes as its response the segmentation of the egg. Boveri, indeed, maintained that the union of the two pronuclei had nothing to do with providing this stimulus, and was able to show that an enucleated egg may develop after fertilisation by a spermatozoon. According to Boveri the centrosome is the organ of cell-division, and the unfertilised egg cannot develop because the centrosome is wanting. A new centrosome is introduced by the spermatozoon, and then cell-division or segmentation commences.

Loeb, however, maintains that the development of the egg is a chemical process, depending mainly on oxidation, in which there takes place a synthesis of nuclear material from constituents of the cytoplasm. He accordingly regards the Boverian hypothesis, in which a purely mechanical *rôle* is assigned to the centrosome, as inadequate to explain the nature of fertilisation. His earliest experiments consisted in treating the eggs of a sea-urchin with sea-water, the alkalinity of which had been increased by the addition of soda-lye. In such water the eggs segmented once or twice, but did not develop further. On the other hand it was found possible to cause the unfertilised eggs to develop into larvæ by placing them for a couple of hours in hypertonic sea-water—sea-water, that is, the osmotic pressure of which had been raised about 60 per cent. by the addition of some kind of salt or sugar. This apparently purely osmotic stimulation of the egg was subsequently found to comprise two factors, viz., the loss of water by the egg, and the concentration of the hydroxyl-ions of the hypertonic solution. It was also found that the hypertonic solution can only stimulate the egg to development if it contains free oxygen in sufficient quantity.

The author next succeeded in producing larvæ from unfertilised eggs of Chætopterus by means of potash and acids without raising the osmotic pressure of the sea-water.

It has long been known that the eggs of many animals, immediately after the entrance of the spermatozoon, form a "fertilisation membrane" on the surface. We used to be told that this membrane served to prevent the entrance of additional spermatozoa. Loeb attributes to it a much deeper significance. He finds that in the case of osmotically "fertilised" eggs no membrane-formation takes place, but a short treatment with a monobasic fatty acid causes the formation of a typical "fertilisation-membrane" in all the eggs of Strongylocentrotus. If such eggs are then placed for a short time in hypertonic sea-water they all develop into larvæ. The artificial membrane-formation by itself, however, in this case only causes the eggs to commence their development without being able to continue it.

The membrane-formation is regarded as the most important factor in fertilisation. It has also, however, a deleterious effect, a tendency to cytolysis, which requires to be counteracted by treatment with a hypertonic solution, or in some other way. In some species the artificial membrane-formation alone is sufficient to bring about the development of the eggs to normal larvæ, the injurious cytolytic effects being less marked than in the sea-urchin. That it is the membrane-formation and not any other action of the fatty acid which brings about the development of the egg is evident from the fact that membranes produced in any other way have the same effect.

The author attributes a like importance to membrane-formation as the essential factor in the normal fertilisation of the egg by the spermatozoon, and proceeds to inquire what substances and agencies determine such formation. Membrane-formation may be regarded as a stage in the cytolysis of the egg, and all cytolytic agents will cause membrane-formation. Clearly the cytolysis must be arrested in some way after the membrane has been formed, otherwise it will lead to the destruction of the egg. Loeb maintains that in the natural fertilisation of the egg the formation of the fertilisation membrane is brought about by a "lysin," carried by the spermatozoon, which also brings with it a second substance which serves to counteract the evil effects of membrane-formation.

Such is the essence of the "Lysin Theory" of fertilisation. As an attempt to interpret biological phenomena in terms of chemistry and physics, it is of the greatest interest, though the point of view from which its author regards the phenomena of fertilisation may not be the one which appeals most strongly to students of biology.

We do not doubt that a new edition of this extremely interesting work will shortly be called for, and we hope that it may be found possible to publish it simultaneously in German and English. Not the least valuable feature of the book is, to our mind, the introduction of twenty-one pages, in which a concise *résumé* of the entire subject is given.

[1] "Die chemische Entwicklungserregung des tierischen Eies (Künstliche Parthenogenese)." By Jacques Loeb. (Berlin: Julius Springer, 1909.) Price 9 marks.