Three methods have been used singly and in various combinations in this study. By the plasmolytic method a separation of the hyaline plasma-layer from the vitelline membrane is easily affected. Vital staining differentiates clearly the various structures on the surface of the egg. Janus Green (dimethylsafraninazodimethylanalin) in dilute solutions stains the egg-jelly light blue. It is also beautifully demonstrated by a number of other vital stains. In concentrated solutions of janus green the jelly shrinks to a mere hull. Slightly concentrated solutions of isamin blue, dissolved in sea water by boiling, stain the swollen vitelline membrane a deep blue while the hyaline layer is much lighter in color. Toluidin blue stains the hyaline layer of the cytoplasm and the vitelline membrane, but as a differential stain it does not equal isamin blue.

The removal of the egg-jelly and vitelline membrane from the fertilized and unfertilized eggs was affected by dissection with glass needles made from very hard Jena glass tubing about 5 mm. in diameter. The points on many of these needles measured less than one half micron. The needles were held in a Barber pipette-holder and the dissections made under a magnification of five hundred and sixty-two diameters.

It seems that the type of reaction described for the egg of *Arbacia* is a somewhat common one, since essentially the same changes occur in the eggs of *Chætopterus* and the mollusk *Cumingia*. In these two forms the maximum swelling of the vitelline membrane does not occur until about twenty to thirty minutes after insemination of the eggs.

An analysis of the reaction of the egg of *Arbacia* to the spermatozoon has been attempted. Puncture of the vitelline membrane has failed to produce the reaction. Doses of from one to five spermatozoa have been injected into the egg-jelly and the relation between the time required for the penetration of the vitelline membrane by the spermatozoon and the extent and location of the swelling of this structure have been studied. By injecting spermatozoa into the egg-jelly, in a small percentage of cases a single spermatozoon becomes attached to the vitelline membrane and produces the reaction that has been described. The passage of the spermatozoon through the vitelline membrane has been observed in a number of eggs. It has been found possible to remove the spermatozoon from the vitelline membrane after it has caused the reaction. The real difficulty in this type of experiment is not the size of the spermatozoon, but the fact that when even four or five spermatozoa are injected into the egg-jelly they usually swim out and away from the egg. This necessitates the making of many injections in order to get a single spermatozoon to attach itself to the vitelline membrane and start the reaction.

As far as my evidence goes at the present time it seems that the primary function of the much discussed reaction of the egg of *Arbacia* to the spermatozoon is the prevention of polyspermy.

The details of this study will appear later.

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A SIMPLE METHOD OF MAKING ARTIFICIAL CELLS RESEMBLING SEA URCHIN EGGS IN CERTAIN OF THEIR PHYSICAL PROPERTIES

SEVERAL years ago Robertson showed that if chloroform was shaken with egg-albumen solution, the droplets would not reunite even when washed in water, because of the formation of a proteid film on the chloroform surface. It can be readily observed that such droplets shrink in volume, owing to the passage of chloroform into the water outside.

While studying the penetration of alkalies into lecithin in various solvents, I noticed that if lecithin is dissolved in chloroform and the solution shaken with proteid solutions, the chloroform of the resultant globules is in time completely replaced by water. Eventually, then, instead of lecithin in chloroform, we may obtain small cells of lecithin in water sur-

rounded by a fine proteid membrane. This membrane is impermeable to lecithin.

During the exchange of water for chloroform a characteristic structure appears in the droplet. It is at first clear but within 30 seconds becomes filled with a dense mass of granules (probably water) so that it looks white against a dark background. The droplet is still mostly chloroform, as may be determined by pricking it with a needle. The contents do not mix with the water.

In the course of an hour, the dense granular structure disappears and the drop clears. There remain only a few dense granules (probably some form of lecithin) mostly aggregated together to form an excentric knot like a karyosome. It is in this stage, which is stable and persists until destroyed by bacteria, that the resemblances to sea urchin eggs are most marked.

If pricked with a needle the contents flow slowly out as a viscid protoplasm-like mass and mix (except the granules) with the water. No chloroform is now present.

The cells are not rigidly spherical in shape, as oil globules suspended in water, but present exactly those slight irregularities which may be observed in freshly laid sea urchin eggs.

The surface film is similar to the surface membrane of a sea urchin egg in appearance and also in consistency, as indicated by its resistance to pricking and to pressure.

Neutral red is accumulated from dilute solution by the cell as a whole but in particular by the granules, which stain very deeply.

Such red stained cells are turned yellow at the same rate by $n/2{,}000$ NaOH and $n/2{,}000$ NH_4OH. In regard to their permeability relations they therefore differ markedly from marine eggs, which are entered much more rapidly by NH_4OH. They possess also no polarity except one attributable to gravity.

These artificial lecithin cells resemble egg cells in one more important and striking respect. If a trace of saponin is added to the sea water in which sea urchin eggs lie, the eggs almost instantly swell and the contents become more fluid and clear, *i. e.*, the eggs cytolyze. Exactly the same thing happens when a trace of saponin is added to water containing lecithin cells. They swell and become clear spheres with only a few granules in the interior. The similarity is indeed perfect.

Future work may indicate methods by which protein can be obtained within a lecithin membrane, the whole of a size comparable with cell size, or can be introduced into lecithin cells. Such cells promise to exhibit even more striking and interesting properties than those herein described.

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A METHOD OF DETERMINING THE AVERAGE LENGTH OF LIFE OF FARM EQUIPMENT

IN determining the cost of farm operations one of the most difficult items to determine accurately is the rate of depreciation of farm equipment. Recently Mr. H. H. Mowry, of the Office of Farm Management, who has collected extensive data on the problem of depreciation of farm equipment, suggested to the writer the possibility of determining the average length of life of a farm implement from data relating to the number of years each implement has been used. Apparently a solution for this problem has been found. The solution applies to all objects, either animate or inanimate, lasting for varying lengths of time.

Two cases are to be considered, namely, (1) when the number of the objects under consideration is approximately constant from year to year, and (2) when their number is increasing or decreasing. The first case may be conveniently considered in its application to farm dwellings. Suppose that on a given group of farms there is a definite number of farm dwellings of various ages, and that as fast as old dwellings become unsuited to their purpose they are replaced by new ones. For convenience of reference let us reduce the numbers with which we have to deal to symbols. Let N_1 represent the number of dwellings in their first year of life, N_2 the number in their second year, N_3 the number in their third year, and so on, N_n representing the