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On the nature of the process of fertilization.

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Two years ago I showed that the process of natural fertilization of the sea urchin egg could be imitated by the combination of two agencies: first the artificial production of a membrane around the egg and second the treatment of the egg for some time with hypertonic sea water. I expected that this imitation of the natural process of fertilization by external agencies might lead to a discovery of the ultimate chemical character of the process of fertilization and this proved to be true to that extent that I was able to show in a series of papers, published a year ago, that the essential effect of the natural or artificial fertilization is a calling forth of oxidations in the egg. These oxidations are the prerequisite for the synthesis of nuclein compounds from protoplasmic constituents of the egg, and this synthesis which forms the first stage in the developmental process. It may be that the formation of nucleins is an oxidative synthesis.[1]

When we produce artificially a membrane around the egg by treating the latter for a couple of minutes with a monobasic fatty acid, the egg forms after a certain time two astrospheres, but begins to disintegrate very rapidly. If the temperature is very low it may segment and even reach a blastula stage. I was able to show that the development as well as the disintegration only occur in the presence of free oxygen. If we substitute carefully washed hydrogen for the air in the sea water or if we prevent the oxidations in the egg by the addition of a trace of KCN to the sea water the eggs will neither develop nor disintegrate. From this I concluded that the process of membrane formation calls for or accelerates in the egg oxidations which lead to the formation of the two astrospheres and — if the temperature be sufficiently low — to a series of cell divisions. But these oxidations lead also to the

[1] Loeb: *Biochemische Zeitschrift*, i, p. 183, 1906; ii, p. 35, 1906. *University of California publications*, iii: p. 1, p. 33, p. 39, p. 49, 1906. *Pflüger's Archiv*, cxiii, 1906.

formation of toxic compounds which cause the comparatively rapid disintegration of such eggs. If, however, such eggs are put immediately or soon after they have gone through the process of membrane formation into hypertonic sea water for from 30 to 60 minutes, they may all develop at ordinary room temperature and a percentage of these eggs segments perfectly normally and develops into normal embryos. The hypertonic sea water has however this effect only when it contains free oxygen. If we substitute hydrogen for the air contained in it or if we prevent the oxidation in the egg by adding a trace of KCN to the hypertonic sea water, the eggs will not develop but disintegrate in the way characteristic for eggs with artificially produced membranes that have not been treated with hypertonic sea water. From this I concluded that the hypertonic sea water modifies the process of oxidation in the egg and leads the oxidations into the right channels. There remained, however, an apparent difficulty. In my original experiments on artificial parthenogenesis, not two but apparently only one agency was employed to cause the developement of larvæ from the unfertilized egg of the sea urchin, namely, an increase in the osmotic pressure of the sea water. My recent experiments here, however, show that in this purely osmotic method of artificial parthenogenesis, we are in reality dealing with a combination of two different agencies, one being the increase of the osmotic pressure at a comparatively low concentration of hydroxyl ions, the second the hydroxyl ions at a comparatively high concentration. The proof for this statement rests upon the following experimental facts.

(*a*) When the concentration of the HO is below a certain limit, namely, $10^{-6}n$ even the maximal increase of osmotic pressure fails to cause the formation of larvæ from the unfertilized eggs.

(*b*) When the concentration of hydroxyl ions is high, *e. g.*, $10^{-3}n$ a very slight increase of the osmotic pressure is able to call forth the formation of larvæ.

(*c*) The effects of the two agencies can be separated by first putting the eggs for from 1½ to 2 hours into a hypertonic solution with a concentration of hydroxyl ions between 10^{-7} and $10^{-6}n$ and afterwards transferring them for some time to an isotonic solution with a concentration of hydroxyl ions of about 2 or $4 \times 10^{-3}n$. While no egg that has been exposed to the hypertonic solution will develop, many or possibly the majority of the eggs that have in addition been exposed to the hyperalkaline solution will develop into larvæ many of which are perfectly normal and rise to the surface. I have further found that the eggs which develop into larvæ very often (possibly always) have a membrane which, however, differs from the fatty acid membrane or the fertilization membrane in this, that it is not separated by so wide a space from the protoplasm and therefore easily escapes detection.

In a former paper I have already pointed out that the facts of natural fertilization agree also with the view set forth in the introductory remarks of this note.

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Comparative chemical composition of the hair of different races.

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Forty-five samples of hair were analyzed, the specimens being obtained from indian, negro, japanese and caucasian subjects. After subjecting the hair to the action of digestive juices and alcohol and ether the percentage content of sulphur, nitrogen, carbon and hydrogen in the remaining keratin was determined. The analyses indicate that the chemical composition of human hair is influenced by six factors, as follows: (1) Race of the subject; (2) sex of the subject; (3) age of the subject; (4) color of the hair; (5) purity of breeding of the subject; (6) whether the hair sample is obtained from a dead or living subject.

The *average* percentage composition of the forms of hair (keratin) analyzed is given below.

Subject.	Elementary percentage composition.					Ratio.
	S	N	C	H	O	S:N
Indian	4.82	15.40	44.06	6.53	29.19	1 : 3.2
Japanese	4.96	14.64	42.99	5.91	31.50	1 : 3.0
Negro	4.84	14.90	43.85	6.37	30.04	1 : 3.1
Caucasian:						
Adults	5.22	15.19	44.49	6.44	28.66	1 : 2.9
Children	4.93	14.58	43.23	6.46	30.80	1 : 3.0