that the X-ray changes were distinctly local in character. It further is clear that the effect in the case of the third chromosome was less than a chromosome in length, since had it not been so both characters scarlet and claret would have appeared as the eye color orange instead of only one of the factors showing.

The data furnish some information on the mechanism by which the gene acts to produce its end product. As it is possible to change the gene in a cell before this gene has manifested its appearance, it is evident that the gene is potentially present in every cell which eventually forms the eye during the entire embryology of the animal, governing its destiny throughout development. The patches of cells which result from the cell in which the mutation was originally brought about are absolutely sharp and distinct from those not so changed. There is no intergrading of the two areas of cells in color. The action of the gene must therefore be within the cell in which it is contained and on no others. On this view the classic reaction, gene $\longrightarrow$ enzyme $\longrightarrow$ end product, must be all cell-contained, or an all-or-none reaction. Such a view presents difficulties which, without any definite proof for the enzyme stage, would seem to be best treated as still a gene-to-end-product reaction taking place within each cell. The facts thus point to the gene as present at each embryological stage in an organ's development and capable of changing this organ at any stage at which the gene itself is changed.

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THE FUNCTION OF THE FERTILIZATION MEMBRANE IN THE DEVELOPMENT OF THE LARVA OF THE SEA URCHIN

IT is possible to secure fertilization and development of the egg of the sea urchin without the formation of either the fertilization or the hyaline membrane. If unfertilized eggs of *Strongylocentrotus purpuratus* are put into an isosmotic solution of urea for two minutes and then transferred to sea-water containing sperm, the eggs are fertilized, but no membranes of any sort appear on them or subsequently on the blastomeres. Nuclear and cytoplasmic division go on, but the blastomeres are loosely strung together, resembling colonies of yeast cells. The cells usually lie in one—not more than two layers. In twenty-four hours the cells are quite small and have largely lost contact with each other as they lie on the bottom of the dish. The loss of the membrane precursor in the solution of non-electrolyte is irreversible, since if unfertilized eggs, after being kept in the solution of urea, are transferred to sea-water for thirty minutes and then fertilized, they develop exactly as do those eggs which are fertilized immediately after removal from the solution of non-electrolyte. There is no regeneration of membrane precursor.

The addition of Na or K ions does not alter the effect of the solution of non-electrolyte, except that eggs which had been kept in a solution consisting of 50 cc urea M/1 + 1 cc K Cl M/2 before fertilization, during development show ameboid forms. On the other hand, Mg, Ca, or Sr ions when added to the urea solution protect the egg by preventing the outward diffusion of the membrane precursor. If the eggs are kept two minutes in a solution consisting of ½ cc of ⅜ M solution of either $MgCl_2$, $CaCl_2$ or $SrCl_2$ + 50 cc urea M/1, and are then fertilized in sea-water, they form a comparatively inelastic membrane which closely invests the egg. This is membrane formation without elevation. As a result, nuclear division occurs without immediate cytoplasmic division, and the larva is a solid blastula not larger than the unfertilized egg since it is kept from swelling by the closely investing membrane. The addition of 2 cc of a solution of either $MgCl_2$ or $CaCl_2$ results in very nearly complete protection of the eggs, so that when they are fertilized, the fertilization membrane is formed and also elevated as in normal eggs. As a result, division is approximately normal and blastulae with cavities are formed. It is of interest to note that in this reaction Mg ion is equal to Ca ion in protective action, indicating a valence effect. In other physiological processes Ca ion is five to ten times more powerful in toxic or antagonistic action, than Mg ion. Sr ion is approximately twice as effective as either Mg or Ca. This shows a qualitative action in addition to the valence effect.

The results prove that membrane formation is of fundamental importance to the development of organisms consisting of closely associated groups of cells, *i.e.*, metazoa. Furthermore, the results show the difference between membranes which are definite anatomical structures, *i.e.*, the fertilization membranes and plasma membranes. In the typical case of division without membrane formation the cells are well rounded and separate, each cell has a globular form indicating the presence of a plasma membrane, but if the eggs have previously been treated with a solution of urea containing K ion then the plasma membranes are weakened to such an extent that the cells resulting from division may coalesce and show ameboid forms.

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