STAMENS AND OVULES OF CARNEGIEA GIGANTEA

Through the courtesy of Director MacDougal of the Desert Botanical Laboratory at Tucson, Arizona, a lateral branch of the giant cactus (*Carnegiea gigantea*), measuring about a meter in height and twenty centimeters in diameter has been blossoming at intervals since May in the botanical plant houses of the University of Nebraska. No less than five distinct sets of flowers have appeared in this time.

From the first the number of stamens interested us, and some estimates were made of their number, but these varied so much that at last it was determined that the only thing to do was to make an accurate count of the stamens. Accordingly Mr. R. E. Jeffs, a fellow in botany, was asked to determine the number by enumerating every stamen, not making any *estimate* whatever. The result was astonishing, for it was found that there were 3,482 stamens in the flower, probably the largest number recorded for any flower.

This quite naturally raised the question of the number of ovules in the same flower, and Mr. Jeffs accommodatingly counted these also, with the result that he found 1,980 ovules. Here again the number is unexpectedly large, but the result is by no means as astonishing as in regard to the stamens. These figures are deemed worthy of publication.

Charles E. Bessey
The University of Nebraska

SPECIAL ARTICLES

ACTIVATION OF THE UNFERTILIZED EGG BY ULTRAVIOLET RAYS

The sterilizing effect of the ultraviolet rays suggested the possibility that with their aid unfertilized eggs could be induced to develop, since the writer's previous experiments have shown that any substance which acts as a cytolytic agency can also produce artificial parthenogenesis. It was found, indeed, that the unfertilized eggs of the sea urchin *Arbacia*, as well as those of the annelid *Chætopterus*, can be caused to develop by a short treatment with the Heraeus quartz mercury arc lamp. The lamp was fed with a current of 3.4 amperes, the voltage of which was 220. The alleged candle power of this light was 3,000. The eggs were at the bottom of a glass dish covered by a layer of 2 cm. of sea water. The dish was open on top and it stood directly under the lamp at a distance of 15 cm. In order to prevent the temperature of the eggs from rising above the normal room temperature the glass vessel containing the eggs was surrounded by melting ice. The eggs formed a single layer on the bottom of the dish, since it seemed that the eggs lying on top screened the eggs under them from the effect of the ultraviolet light.

When unfertilized eggs of *Arbacia* were exposed to the ultraviolet light for ten minutes, many and sometimes all formed fertilization membranes. In some of the eggs this membrane was only the fine gelatinous film which the writer called an atypical membrane; others possessed a typical normal fertilization membrane. When nothing further was done with the eggs they underwent, at room temperature, cytolysis without segmentation. When the temperature was below room temperature (about 12° C.) some of the eggs segmented into two or four cells, but then perished. When the eggs were put for twenty minutes into hypertonic sea water, about ten minutes after the treatment with ultraviolet light, they developed into larvæ. The eggs had suffered, however, since few developed beyond the gastrula stage. When the eggs were exposed too long to the ultraviolet light (*e. g.*, twenty minutes) they formed fertilization membranes, but were injured to such an extent that they could no longer segment or develop.

It was of interest that a cover glass of 0.1 mm. thickness prevented all effects of ultraviolet light even if the eggs were exposed forty or sixty minutes. Such eggs remained normal. A layer of from 2 to 6 cm. of sea water did not prevent the effect of the ultraviolet rays. Neither did the rather thick walls of a quartz test tube.

The membrane formation by ultraviolet rays took place in the absence as well as in the presence of oxygen. When unfertilized eggs were put into quartz test tubes from which all the oxygen had been driven out by sending a powerful current of hydrogen through for four

hours, the ultraviolet light still caused membrane formation. This effect of the ultraviolet rays was not prevented by even an excessive quantity of NaCN, which inhibits oxidation in the egg. The membrane formation under the influence of ultraviolet light took place in neutral solutions as well as in weakly alkaline ones.

The calling forth of the membrane formation was due to a direct action of the ultraviolet rays upon the egg and not to a product formed by the rays in the sea water or in the air. For sea water which had been exposed to the influence of the rays, no matter how long, without containing eggs, did not cause membrane formation when the eggs were put into it after the ultraviolet light was turned off.

These experiments show that causation of membrane formation in the unfertilized sea urchin egg and the subsequent inducement to development were due to the direct effect upon the egg of ultraviolet waves below 2607 Å. u., since, according to Dr. and Madame V. Henri, waves below this range can not penetrate a cover glass of 0.14 mm. thickness. It is not possible to state in which way the ultraviolet waves caused the membrane formation in the egg except that it could take place without free oxygen as well as in the presence of NaCN.

The results mentioned thus far were obtained in the egg of the sea urchin. The egg of *Chætopterus,* after an exposure of from five to ten minutes to the ultraviolet rays under the conditions mentioned above, developed into swimming larvæ, without cell division.

Since Röntgen rays are only very short light waves, and since they also cause cytolysis, they should also cause membrane formation of the unfertilized egg. It is of interest that G. Bohn states that Röntgen rays induce artificial parthenogenesis. His experiments were made before the rôle of the membrane formation (or the alteration of the surface of the egg) was recognized as a necessary step in development, and he therefore does not mention whether or not Röntgen rays induce membrane formation.

JACQUES LOEB

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

ON THE FEASIBILITY OF DETERMINING EXPERIMENTALLY THE LUNAR AND SOLAR DEFLECTION OF THE VERTICAL BY MEANS OF TWO CONNECTED WATER TANKS

FOR some time I have had in mind the essentials of the arrangement or apparatus described below, the purpose of which is to ascertain the deflection of the vertical as disturbed from its mean position by the attraction of the moon and sun. It may not be new; but I have never seen it described or referred to elsewhere.

Briefly described, such apparatus would consist of two tanks or cisterns of equal diameters and of equal depths, located some distance apart, upon the same level, and connected by means of a pipe. This pipe should be of metal excepting for some distance near its central portion where a glass section or length of much smaller diameter should be inserted. The pipe should be attached to the bottoms of the tanks in order to avoid complications which would otherwise arise should the temperatures of the water in the two tanks become somewhat unequal. But if the pipes are attached to the bottoms of the tanks, the unequal expansion of the water will not seriously affect the equilibrium and so will not set up any flow of consequence from one tank to the other.

At any given place upon the earth's surface the direction of the instantaneous vertical continually deviates from its mean position by a small angle dependent upon the time (or local hour angle) selected and the positions of the moon and sun relative to the earth's center.

Ignoring the attraction of the disturbed oceans, the plumbline upon an unyielding earth deviates in accordance with the impressed horizontal forces. These forces, in terms of g or terrestrial gravity are:

Eastward force,

$$= -0.0000001684 \cos\lambda[M_2 \sin(m_2 t + \arg_0 M_2) + S_2 \sin(s_2 t + \arg_0 S_2) + \cdots].$$
$$- 0.0000001684 \sin\lambda[K_1 \sin(k_1 t + \arg_0 K_1) + O_1 \sin(o_1 t + \arg_0 O_1) + P_1 \sin(p_1 t + \arg_0 P_1) + \cdots].$$

Southward force,

$$= 0.0000001684 \cos\lambda \sin\lambda[M_2 \cos(m_2 t + \arg_0 M_2) + S_2 \cos(s_2 t + \arg_0 S_2) + \cdots].$$