various radium centers have been considered and assessed by the commission, the allocation of national supplies of radium will be commenced. Orders have already been placed by the trust for 10 gm exclusive of the 4-gm bomb, and it is anticipated that the whole of this should be available before the autumn of 1930. It has been decided to install a radon plant at the National Physical Laboratory for the purpose of supplying (under proper safeguards) radon to hospitals or other institutions which otherwise could receive no direct assistance from the commission for radium therapy.

DISCUSSION

ENVELOPING MEMBRANES OF ECHINODERM OVA

THE fertilization membrane of Echinoderm ova has been made a subject of discussion in two recent communications to SCIENCE, one by A. R. Moore, "The Function of the Fertilization Membrane in the Development of the Larva of the Sea Urchin,"[1] and the other by E. E. Just, "The 'Fertilization' Membrane of Echinid Ova."[2]

The former is a statement of certain facts from which a rather sweeping conclusion is drawn, while the second cites observations on one kind of ovum to refute the conclusion of the former dealing with another kind of ovum.

Moore, using the ova of *Strongylocentrotus purpuratus,* found that eggs treated with urea and subsequently fertilized form no fertilization membranes, and when segmentation sets in the blastomeres fall apart. He concluded that membrane formation (by which he evidently means the fertilization membrane) is of fundamental importance to the development of organisms consisting of closely associated groups of cells. He should have restricted this conclusion to urea-treated Strongylocentrotus eggs.

It is to be deplored that Just makes no mention of the species on which he bases his conclusions. Presumably he has reference to the Woods Hole Echinids *Arbacia punctulata* and *Echinarachnius parma.* In addition to using data of his own on the removal of the fertilization membrane Just gives credit, albeit dubiously, to the micro-dissection method by means of which the vitelline membrane has been removed from the uninseminated eggs of both these species.[3] Such eggs, when subsequently fertilized, segment and develop into normal embryos with no fertilization membranes.

Hence, both investigators are correct if only they had restricted their divergent conclusions to the particular species with which they worked; namely, when the Strongylocentrotus ovum is divested of its fertilization membrane by means of urea its blastomeres do not hold together to develop into an embryo, while the Arbacia and Echinarachnius eggs, on the other hand, are fully capable of normal development without fertilization membranes.

I have not worked with the Strongylocentrotus egg, but from Moore's observation I judge that it closely resembles the Woods Hole Asterias egg in regard to the cohesive properties of the blastomeres. In the Asterias egg the early blastomeres are loosely distributed within the fertilization membrane and only by careful observation can one detect a delicate, secondary membrane, investing the outer borders of the blastomeres and extending between them. This membrane, which develops on the surface of the egg several minutes after the fertilization membrane is lifted off, is too weak to hold the blastomeres together so that they would fall apart if it were not for the externally investing fertilization membrane. Moreover, this secondary membrane is formed only when a bivalent electrolyte (Ca or Mg) is present in the surrounding medium.

In the Arbacia and Echinarachnius egg a similar secondary membrane is formed, the so-called hyaline plasma layer, and it is strong enough to hold the blastomeres firmly together without the aid of the fertilization mebrane. This secondary membrane can be torn with micro-needles, in which case the blastomeres fall apart.[4] This and the fertilization membrane constitute the anatomical structures (quite apart from the true plasma membrane of each individual cell) which Moore rightly concludes are necessary to permit normal development by keeping the cells closely associated.

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[1] 70: 360, October 11, 1929.

[2] 71: 243, February 28, 1930.

[3] Chambers, *Biol. Bul.,* 41: 318, 1921.

[4] *Anat. Rec.,* 25: 121, 1923.

THE ELECTRON AND RADIATION

THE electron has been shown[1] in several ways by me to possess certain fundamental properties. It is of course desirable that this result should be obtained in as many ways as possible, and one more will therefore be given here.

Consider a closed chamber with perfectly reflecting walls whose total mass is infinitely large so that they may withstand any pressure. Suppose that the chamber contains a single free electron, and a par-

[1] *Phil. Mag.,* 7: 493, 1929; SCIENCE, 70 (1820): 479, 1929.

ticle of matter to insure that the chamber contains black body radiation. Further suppose that an alternating electric field is applied to the chamber so that the electron moves to and fro, but without touching the walls. If the electron is perfectly reflecting it will perform work upon the radiation, and the temperature will accordingly continually increase till the radiant energy per cc is infinite. But such a concentration of energy, we may take it, is impossible. The electron can not therefore be perfectly reflecting, or it absorbs besides reflects radiant energy. Now a continual increase in its internal energy through absorption of radiation on account of its motion is not permissible, since in that case its internal energy would ultimately become infinitely large, and hence it is periodically converted into some other form. This can not be radiation produced by acceleration, since the energy required for this is derived from the kinetic energy of the electron, or the energy of the applied field. The internal energy must therefore be converted directly into radiation, and hence the electron may radiate in two entirely different ways.

But even under these circumstances the applied field will perform work upon the electron, for the energy converted into radiation through acceleration may be varied through the applied field, and this work ultimately appears as radiation. Thus the density of the radiation may be made infinitely large, which we have seen is impossible. It follows, therefore, that ultimately the applied field should have no effect on the electron, or that its field decreases till zero. Since the temperature under these conditions will be very large, causing a large absorption of radiant energy by the electron, its average amount of internal energy will in consequence be very large. Thus in a general way the external field of an electron decreases with increase of its internal energy.

We might also in the beginning have supposed that the force on the electron decreases with increase of density of radiation. Since the density would nevertheless become infinite, we must suppose that the force becomes zero for a finite density. This is possible only if the electron undergoes a change, which naturally involves a change in internal energy, and so on.

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NOTE ON HAEMOGLOBIN

DURING the course of a spectrographic examination of horse and fowl haemoglobin we have noted that the absorption band, whose peak appears at AU4100 for oxyhaemoglobin and AU4300 for haemoglobin in solutions of the above compounds, does not appear when washed corpuscle suspensions containing haemoglobin and oxyhaemoglobin in similar concentrations are examined. Furthermore the absorption which begins at AU2500 in solutions of horse haemoglobin also is absent when haemoglobin or oxyhaemoglobin is observed in washed cell suspensions. The specific bands in the visible regions of solutions of the above pigments are observed in the washed cell suspensions in their usual location.

Apparently there is, in the case of haemoglobin in the cell, a possibility that it is in combination with some constituent of the corpuscle. This problem is one of several concerning the blood pigment for which we are attempting to find a solution.

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A FOSSIL MAMMAL WITH UNBORN TWINS

THE South Dakota State School of Mines has recently mounted and placed on exhibition in its geological museum a most unusual fossil vertebrate specimen from the Oligocene of South Dakota. This is a superbly preserved skeleton of a mother *Oreodon* (*Merycoidodon*) *culbertsoni* with unborn twins. It is the only known occurrence of a fossil mammal accompanied by unborn young.

The specimen was found by the School of Mines collecting party of 1928, Mr. James Bump, Mr. Robert Hernon and Mr. Harold Martin, in the Lower Oreodon beds of Cain Creek, about two miles north of Imlay in the heart of the Big Badlands. Only a small portion of the skull of the mother was exposed to the weather. Excavation disclosed the complete skeleton except that the ribs on the right side were mostly missing. Upon turning over the block in the field for final shellacking and other protection, the skulls of two unborn individuals, lying within the pelvic region, were discovered. A photograph of the rough block made in the preparing room before work was begun upon it shows in good way much of the skeleton of the mother and the positions occupied by the twins.

The mother skeleton, the right side showing, is mounted in relief on a nicely tooled slab. The skeletons of the twins are only partially preserved. Some of this loss is due doubtless to the cartilaginous, nonpetrifying nature of the material. The better portions are the skulls and some of the larger leg bones. The skull of one is well preserved and nearly perfect. The other may be easily discerned but is much crushed and the parts displaced. Both skulls show well-developed teeth. The cranial bones are very thin and delicate and much care was necessary to prevent injury to them. In the mounting of the specimen