

1936

## The Effect of Ultracentrifuging on the Respiration Activity of Developing and Blocked Embryonic Cells

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### Recommended Citation

Bodine, Joseph Hall and Boell, Edgar J. (1936) "The Effect of Ultracentrifuging on the Respiration Activity of Developing and Blocked Embryonic Cells," *Proceedings of the Iowa Academy of Science*, 43(1), 391-392.

Available at: <https://scholarworks.uni.edu/pias/vol43/iss1/141>

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EFFECTS OF ROENTGEN RAYS ON DEVELOPMENT  
AND RESPIRATION OF GRASSHOP-  
PER EMBRYOS

TITUS C. EVANS

Roentgen rays have been found to have many and varied effects on the development of the grasshopper, *Melanoplus differentialis*. Development may be completely inhibited, partly injured, or only temporarily retarded by proper dosages of Roentgen rays. Irradiation at a certain stage (5 to 6 days, 25° C) results in the formation of aberrant growths and the occasional duplication of formed parts. The most rapidly growing parts, and embryos developing rapidly, are more quickly affected by irradiation. The appearance of injury may be prolonged by stopping development either by cold (5° C) or by means of the natural block (diapause). When development is stopped by irradiation, the rate of respiration fails to increase with time as does that of the controls. If the nuclear end of the one day egg is protected with lead and the yolk thus irradiated with more than enough to kill the nuclei had they been exposed, the rate of oxygen consumption is not retarded at all and in some cases it is even increased. During diapause the respiration does not respond quantitatively to irradiation. It appears that the retardation of oxygen consumption rate noted when developing eggs are irradiated is due to the decrease in embryonic material rather than to a direct effect on the respiratory mechanism.

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THE EFFECT OF ULTRACENTRIFUGING ON THE  
RESPIRATORY ACTIVITY OF DEVELOPING  
AND BLOCKED EMBRYONIC CELLS

JOSEPH HALL BODINE AND EDGAR J. BOELL

The effects of high rotational speeds as obtained through the use of the ultracentrifuge have been studied on the oxygen uptake of the eggs of the grasshopper, *Melanoplus differentialis*. The

respiration of actively developing eggs is profoundly depressed after centrifugation by forces ranging from 1500 to 400,000 times gravity. The respiration of blocked eggs (in a state of physiological quiescence of diapause) remains unaffected after centrifugation by forces of the magnitude indicated. Complete stratification of the egg contents occurs in all eggs, regardless of their physiological state, with rotational forces in excess of 1800 times gravity. Recovery of the eggs from the effects of centrifugation (as evidenced by hatching) occurs after exposure to dosages of 20,000 times gravity or less.

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## RESPIRATORY ACTIVITY OF GRASSHOPPER EMBRYO AS CONTRASTED WITH INTACT EGG

JOSEPH HALL BODINE AND EDGAR J. BOELL

An attempt has been made to localize the important respiring components of the grasshopper egg and to estimate the relative respiratory intensity of each.

Prior to the process of blastokinesis or yolk engulfment, the differentiated embryo is responsible for only one-third of the oxygen uptake shown by the intact whole egg. This figure remains approximately the same in the blocked or diapause state, where development is at a standstill, as well as in pre- and post-diapause states where cell division and differentiation are actively occurring. Respiration of the whole egg in developmental states is 4 - 5 times greater than during diapause, and the same general difference in magnitude of  $O_2$  uptake is exhibited by the embryos. In terms of unit mass of respiring material, the respiratory activity of the embryonic cells is 10 times greater than that of the extra embryonic material.

During blastokinesis the extra embryonic materials in the egg are engulfed by the embryo where they are gradually incorporated into differentiated embryonic structures. At the completion of this process the respiration of the embryo is the same as that of the intact egg. In the remaining days of development before hatching the embryos show an  $O_2$  uptake in excess of that of the whole eggs. This is due to the fact that in such older embryos vigorous appendicular and abdominal movements are possible after the