While the hepatic lesions dominate the picture, less conspicuous degenerative changes are present in other organs, particularly the gonads and the spleen. Transmission experiments conducted with axolotls brought from other laboratories indicate that the disease is infectious.

The authors would appreciate hearing from any one who has encountered similar disease in axolotls or related cold-blooded forms.

CRANFORD HUTCHINSON
THE WISTAR INSTITUTE
BALDUIN LUCKÉ
UNIVERSITY OF PENNSYLVANIA

SPECIAL ARTICLES

SOME OXIDATIVE PROPERTIES OF ISOLATED AMPHIBIAN GERMINAL VESICLES

THE classical opinion which considers the nucleus as a center of respiratory metabolism has been recently questioned by several investigators. The rH measurements of Rapkine and Wurmser[1] and of Chambers[2] and his collaborators failed to indicate any considerable oxidizing or reducing ability in the nucleus; likewise, experiments in which the metabolic rate of non-nucleated and nucleated fragments of Arbacia eggs (obtained by ultracentrifugation) was compared show no particular respiratory activity in the nucleus (Shapiro,[3] Navez and E. B. Harvey[4]).

In view of these divergent opinions, it was of interest to study the respiration of isolated amphibian germinal vesicles; the removal of the nucleus in full-grown oocytes is a rather easy task (Duryee[5]) and a sufficient amount of material can be obtained in a short time.

Some preliminary tests carried out on *Rana fusca* isolated germinal vesicles indicated that the nuclear sap and the nucleoli are able to reduce methylene blue; leuco-methylene blue is specially oxidized by the nucleoli. On the other hand, chemical tests for indophenoloxidase, peroxidase and glutathione were entirely negative.

In order to get quantitative data, the CO_2 elimination of *Rana fusca* germinal vesicles was measured by a microtitrimetric method and the oxygen consumption of Triturus pyrrhogaster isolated nuclei was followed in a modified Gerard-Hartline microrespirometer, kindly placed at my disposal by Dr. Herbert Shapiro. The metabolism of full-grown oocytes deprived of their follicular epithelium was estimated at the same time. The Qo_2 (mm^3 O_2 per gr wet weight per hour) of the isolated nuclei was found to be about 13, while the Qo_2 of the oocyte is around 37. In both cases, the metabolism remained constant during several hours. If the respiration of one single nucleus is compared to the metabolism of one oocyte, it is found, both for oxygen consumption and for carbon dioxide elimination, that the gas exchange of the nucleus represents from 1 to 1.5 per cent. of the metabolism of the whole intact cell. It is often possible in *Rana fusca* to remove the nucleus from the oocyte without much loss of cytoplasm; if this enucleated egg-cell is allowed to heal and CO_2 elimination is measured, it is found that the loss of the nucleus does not induce any considerable drop of the metabolism during many hours.

In order to check the possibility that the low respiration of the isolated nuclei might result from an insufficient amount of oxidizable substrate, either glucose or cytoplasm removed from an oocyte by means of a micropipette was added to the germinal vesicles; no definite increase in the metabolic rate could be detected in such conditions.

The influence of calcium on the physical properties of the chromosomes in isolated germinal vesicles has been demonstrated by Duryee; but the presence or absence of Ca ions did not affect significantly the oxygen consumption or the carbon dioxide elimination in these experiments.

These observations indicate that the nucleus is probably not a center of high metabolism in the growing oocyte, although the importance of the germinal vesicle in other respects must not be overlooked.

JEAN BRACHET
DEPARTMENT OF BIOLOGY
PRINCETON UNIVERSITY, AND THE
EMBRYOLOGICAL LABORATORY
MEDICAL SCHOOL
UNIVERSITY OF BRUSSELS

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COBALT AS AN ESSENTIAL ELEMENT IN ANIMAL NUTRITION

NATURAL conditions have been encountered in west Australia, New Zealand and Florida (the latter probably extending over the coastal plains of the Gulf and Atlantic coasts) in which cobalt must be supplied for the well-being of sheep and cattle. General observations indicate that the effects of the deficiency may affect other animals and even people on a "live-at-home" diet.

Filmer and Underwood[1] reported in 1934 the preparation of an iron-free filtrate from a limonite effective

[1] J. F. Filmer and E. J. Underwood, *Australian Vet. Jour.*, 10: 83–92, 1934.

in preventing enzootic marasmus in sheep. Fractionation of this filtrate and tests of the elements in the effective fraction resulted in Underwood and Filmer[2] announcing in 1935 that cobalt was the potent element in effective limonite. This was the first evidence that cobalt was an essential element.

At that time, Grimmett and Shorland[3] held that iron *per se* was necessary for the prevention of "bush sickness" in New Zealand, but that cobalt and other elements might have a stimulating effect. Denham[4] has reviewed the present status of the investigation of cobalt deficiency in New Zealand. Ferric ammonium citrate and iron ores effective in preventing bush sickness or "skinnies" owed their efficacy to their cobalt content. Other ores that were ineffective did not have equivalent cobalt contents. Cobalt alone has been effective in the more recent experiments.

In Florida, on certain soil types, ferric ammonium citrate or a commercial red oxide of iron and copper sulfate have been effective in overcoming a nutritional anemia in cattle known as "salt sick." On other soils, this treatment has been ineffective in inducing and maintaining normal function due to an overlapping of cobalt deficiency. In controlled feeding experiments with calves on a ration of Natal grass (*Tricholena rosea*) hay, shelled corn and dried skim milk, a malnutrition has been produced that is corrected by cobalt supplement, and apparently is aggravated by the use of ferric ammonium citrate and copper sulfate. None of these feeds showed cobalt to be present upon spectrographic examination.

Affected animals show a long rough hair coat, scaliness of the skin, listlessness, retarded development of sexual characteristics, gauntness due to loss of appetite and muscular atrophy. The erythrocyte count may be above average, and the hemoglobin concentration equal to or above that in animals receiving cobalt and making normal growth. Volume and color indices show that the condition is a microcytic hypochromic anemia. The spleen is shriveled and fibrous and the heart of normal size but usually flabby.

Examples of growth rates of Jersey calves are shown in Fig. 1. Animal No. E-79, receiving 5 mgs cobalt per day, made uniform gains until he weighed over 550 pounds. Irregularities in his growth curve and that of E-74 at the higher weights may be attributed to a marginal cobalt intake or to an additional undetermined deficiency. That cobalt intake may have been marginal is shown by the increased growth of E-86 when the cobalt intake was increased. Animal No. E-86, receiving cobalt, weighed 85 pounds more than E-85 on the basal ration at 14 months of age, and

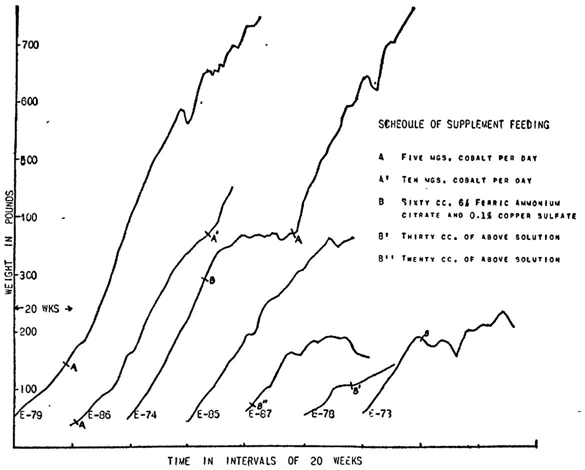

FIG. 1. Growth curves of calves showing the effect of cobalt, and iron and copper supplements, with a ration of Natal grass hay, shelled corn and dried skim milk, the hay and corn being produced on deficient land.

the differences in physical appearance were even more striking. The retarded growth due to the use of ferric ammonium citrate and copper sulfate is shown in the curves for E-74, E-87, E-78 and E-73. No calf has been raised to a weight of over 450 pounds on this ration of Natal grass hay, shelled corn and dried skim milk without the use of a cobalt supplement.

Animal No. E-79, when slaughtered, appeared to be normal, including microscopic examination of the heart, liver and spleen, the organs most affected.

The indispensability of any element in nutrition can be determined only under conditions in which the addition of the element in question is required for a continuance of normal physiological function. These conditions may be encountered naturally or they may be produced artificially. The requirement of animals for certain minerals is so minimal in quantity, and their determination so difficult, that such minerals have not been considered as essential because rations have not been prepared sufficiently free of them to cause a failure of normal functions. Cobalt has been one of these elements.

W. M. NEAL
C. F. AHMANN
FLORIDA AGRICULTURAL EXPERIMENT STATION

MAGNESIUM SULFATE—AN UNSATISFACTORY SUBSTITUTE FOR ARSENICALS IN GRASSHOPPER BAITS

WIDE publicity was given to a short note by Hubert W. Frings and Mable S. Frings which was published in SCIENCE[1] in which a formula with from 20 to 25 per cent. magnesium sulfate (Epsom salts) was recommended as being as effective as 5 per cent. arsenic in grasshopper bait. The communication was printed

[2] E. J. Underwood and J. F. Filmer, *Australian Vet. Jour.*, 11: 89–92, 1935.

[3] R. E. R. Grimmett and F. B. Shorland, *New Zealand Jour. Agr.*, 50: 367, 1935.

[4] H. G. Denham, SCIENCE, 85: 382–383, 1937.

[1] 85: 2209, 428, April 30, 1937.