

was comparable in all groups of heifers. The output of the follicle-stimulating hormone by the anterior pituitary glands was probably similar in all the heifers on the various levels of dietary protein; this is indicated by testes weights from the pituitary assay for gonadotrophin. The data obtained suggest that extremely low intakes of protein in yearling heifers may reduce the luteinizing hormone activity of the pituitary as measured by comb growth.

The data reported herein confirmed the observation made by various other investigators that low dietary protein adversely affected the ovarian activity and manifestation and regularity of estrus in laboratory animals (Guilbert and Goss, 15; Nelson and Evans, 28; Pearson *et al.* 30) and in ruminants (Hart and Miller, 19; Palmer *et al.*, 29). These phenomena may be due in part to the lack of luteinizing hormone rather than to levels of total gonadotrophin as proposed by Guilbert and Hart (16) and Sutton (33). The physiological stress exerted on the heifers as a result of protein deficiency led to clinical anemia and proteinemia. These conditions undoubtedly adversely affected the entire metabolism of the animal and resulted in poor reproductive performance in growing beef heifers. These data confirm those from cattle on pasture experiments by Bedrak (2) in which low protein intake reduced reproductive performance.

There was a high correlation between reproductive activity and rate of gain in the yearling heifers, but this was not true of the two-year-olds. However, there were seven normal embryos from the 10 heifers on the rations showing gains and only four embryos on the rations showing a loss of weight in the two-year-old heifers. The main reason for the smaller number of embryos in the latter two groups was a failure of estrus rather than differential embryonic mortality. The two-year-old heifers were probably not on a low enough protein intake to markedly influence reproduction; also yearlings may have a higher protein requirement than two-year-old cattle.

Blood Constituents and Liver Protein

Hemoglobin.—The analysis of variance for the various blood constituents is shown in Table 9. Yearling heifers in groups I and II maintained their hemoglobin concentration within the normal range, varying between 10.8 and 11.9 percent during the