to kill all the control colony animals. This small difference is therefore a very significant one.

We think that with the development of this DDT-tolerant colony of mice, a useful biological tool has been produced for use in further study of the complex subject of chemical tolerance.

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[1] Weil, C. S., *Biometrics* (3), **8**, 249 (1952).

Spurious Negative Correlation between Age and Weight per Day of Age in Beef Calves

WEIGHT per day of age is commonly used to assess growth in beef calves. It can be shown that there is a very high correlation between weight per day of age and gain per day (Fig. 1), and since the former is a simpler calculation, and does not require a birth weight, it appears on the surface to be a practical substitute for the latter.

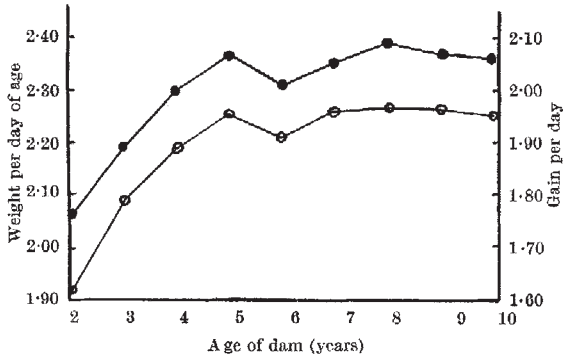

Fig. 1. Correlated change in weight per day of age and gain per day with increasing age of dam in pre-weaning growth period of beef calves. ●, Weight per day of age (lb.); ○, gain per day (lb.)

In 1958 a Canadian technical committee, considering procedures for collecting and summarizing data on beef cattle performance, actually recommended that birth weight be considered as zero in the calculation of growth-rates. This recommendation in effect would substitute weight per day of age for gain per day. Later, in an investigation to determine the magnitude of age of dam effects on pre-weaning growth of beef calves in Canada, the spurious nature of the relationship between weight per day of age and age of calf became clear.

Let us assume that two calves each have a birth weight of 70 lb. One calf is weighed at 120 days of age and is 310 lb., the other is weighed at 250 days of age and weighs 570 lb.

$$\text{Calf 1}\begin{cases}\text{gain per day} = \dfrac{310-70}{120} = 2{\cdot}00 \text{ lb.}\\[2ex] \text{weight per day of age} = \dfrac{310}{120} = 2{\cdot}58 \text{ lb.}\end{cases}$$

$$\text{Calf 2}\begin{cases}\text{gain per day} = \dfrac{570-70}{250} = 2{\cdot}00 \text{ lb.}\\[2ex] \text{weight per day of age} = \dfrac{570}{250} = 2{\cdot}28 \text{ lb.}\end{cases}$$

These calves are exactly equal in their rates of gain; but calf 1 weighs 0·30 lb. per day more than calf 2. This difference is simply because the birth weight of 70 lb. is spread over only 120 days in calf 1 and therefore contributes 0·58 lb. per day, while in calf 2 it is spread over 250 days and contributes only 0·28 lb. per day. The effect of the 70 lb. of birth weight follows a curve of diminishing effect as the age increases until at 700 days of age it contributes only one-tenth of a pound per day of age and is of no particular practical significance. Even in the post-weaning period, however, it is clear that weight per day of age is not a valid measure of growth.

The spurious negative correlation between weight per day of age and age of calf is clearly evident in data gathered on Hereford calves in the Canadian record of performance programme and is illustrated by Fig. 2.

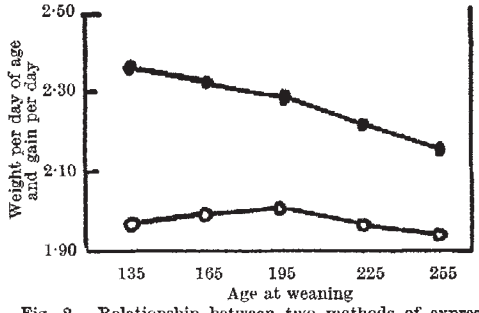

Fig. 2. Relationship between two methods of expressing pre-weaning growth in beef calves as a function of age at weaning. ●, Weight per day of age; ○, gain per day

The lines in Fig. 2 represent the two ways of expressing average growth of the same calves weaned at each age. A total of 5,373 calves are represented. Each sex has been given equal weight in determining each point in Fig. 2. Weight per day of age shows a fairly consistent drop as weaning ages increase while gain per day remains relatively constant.

The negative correlation is masked in Fig. 1 since, within each age of dam class, the average weaning age of the calves is the same within the sampling error and except for any association there may be between weaning age and age of dam.

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ENTOMOLOGY

Control of the Ventral Diaphragm in an Insect

THE control and origin of heart muscle activity present an unresolved problem in many groups of animals. The hearts of vertebrates and many invertebrates contract myogenically, but rate of beat is controlled by nerve fibres associated with the central nervous system. In the arthropod groups neurogenic hearts have been described in the crustacea and *Limulus*[1], and less completely in some insects[2]; but as pointed out by Beard[3] no general pattern of control and origin of heart-beat has emerged in insects.

Many insects possess in addition to the dorsal heart pumping blood anteriorly a large ventral accessory organ driving the hæmolymph posteriorly and dorsally. In the locust *Schistocerca* this ventral diaphragm extends from the metathorax to near the