a case reported by Fraser,[1] an adrenal cortical tumor in a one-year-old male child not only resulted in precocious development of the secondary sexual characteristics but also in precocious skeletal and dental growth. The epiphyses at one year were similar to those in a five-year-old child and the dentition was that of a three-year-old child. These changes may be due to the sex hormones alone, to the adrenal cortical hormones alone or to a combination of these.

The purpose of the present report is to record the changes produced upon newborn rats by certain of the adrenal cortical hormones during the period when the greatest postnatal developmental changes normally occur.

Over 200 newborn albino rats of the Sherman strain were employed. Experiments were performed in which either desoxycorticosterone acetate (DCA)[2] in sesame oil or commercially available aqueous adrenal cortical extracts[3] were injected subcutaneously. These rats were controlled by injections of equivalent amounts into litter-mates of either sesame oil or Ringer's solution. The sexes were about equally divided in the experimental and control groups. A group of 32 newborn rats was observed during the same period, but the rats received no injections whatever. The DCA was injected in daily doses of 0.25 or 0.50 mg and the adrenal cortical extracts in daily doses of 0.1 to 0.6 cc. Within the first 24 hours of life, the preparations, especially DCA, proved toxic and resulted in a high mortality. However, when the injections were begun after the first day, there was no evidence of toxicity and no consistent difference was noted on the body weight between the hormone-injected and the corresponding control litter-mates. Hair growth, determined merely by gross observation, was uninfluenced.

In the hormone-injected rats the incisor teeth erupted approximately on the ninth day of life, which was always about 24 hours earlier than in the control litter-mates. Two to 3 days later the lower lip could be separated easily from the adjacent gingiva, revealing a large extent of the incisor teeth. At this time the lips of the control litter-mates were not as well developed and still firmly attached.

The eyelids of the baby rats began to separate at approximately two weeks of age. The eyes of the hormone-treated rats invariably opened $1\frac{1}{2}$ to 3 days before those of the litter-mate controls. It was quite striking to see the hormone injected baby rats with eyes wide open, when the eyelids of every one of the litter-mate controls continued tightly sealed.

The precocity, as evidenced by the advanced eruption of teeth and opening of the eyes, is based on gross observation. It is believed that many other changes may be taking place which require more detailed study.

Growth hormone, the sex hormones and some other substances which have been injected into baby rats did not influence the time of eruption or of eyelid opening. These experiments will be detailed in a more complete communication.

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[1] I. Fraser, *Brit. Jour. Surg.*, 27: 521, 1940.

[2] Kindly supplied by Ciba Pharmaceutical Products, Inc., and Roche-Organon, Inc.

[3] Three preparations of aqueous adrenal cortical extract were used. One was kindly supplied by the Upjohn Company. We are also indebted to Mr. L. Caplan, of the Comptroller's Office, Inspection Division, City of New York, for a generous supply of Eschatin and of Wilson's Adrenal Cortex Extract.

LACTATIONAL PERFORMANCE AND BODY WEIGHT*

Figure 1 shows the relation of milk-energy production to body weight in mature animals of different species: dairy cattle (average of 368 "good" cows), dairy goats (average of 7 "good" goats) and white rats (average of 5 excellent rat mothers).

The data are generalized by the equation $Y = aW^b$ in which Y represents milk-energy production and W body weight.

The value of *b*, the slope of the fitted line on the logarithmic or percentage grid, is about 0.7: the differential percentage increase in milk-energy yield is 0.7 as rapid as the corresponding percentage increase in body weight; increasing body weight 1 per cent. increases milk-energy yield 0.7 per cent.

The precise numerical value of the slope *b* varies with the relative "dairy merit" of the animals. The significant fact is that milk-energy production tends to vary with W^b and the value of *b* is 0.7 ± 0.1.

This is significant because the minimum maintenance cost (basal energy and endogenous nitrogen metabolisms), weights of neuro-endocrine organs, cross-section areas of the circulatory and respiratory vessels, circulation and ventilation rates, external and nutritive and excretory surfaces vary in similar manner.[1] These percentage parallelisms bring out a fundamental unity in apparently diverse structures and functions.

The fact that these structures and functions tend to vary with $W^{0.7}$ rather than with $W^{1.0}$, might have been inferred from geometrical and mechanical considerations. Geometrically viewed, surfaces tend to vary

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[1] *Univ. Missouri Agr. Exp. Sta. Res. Bulls.* 328 and 335, 1941.

with $W^{2/3}$; mechanically viewed, the pull of gravity varies with $W^{1.0}$ while the strength of the supporting structures tends to vary with $W^{2/3}$ (that is, with the cross-section areas of the supporting structures); hence, to retain stability the supporting structures must grow more rapidly than the visceral organs, or the visceral organs must grow less rapidly than the body as a whole, approximately in proportion to $W^{2/3}$; and it is the metabolism-supporting visceral organs and nutritive and excretory surfaces that condition and limit the functional rates: basal metabolism, apparently milk-production, and perhaps all vital and productive processes. If the small and large animals were similar and if the body did not develop devices for partial compensation of these geometric and mechanical limitations, the slopes of the curves relating these structures and functions to total body weight could be predicted precisely from geometric and mechanical considerations; since, however, small and large animals are not similar geometrically, mechanically or temporally, the value of the slope b in Fig. 1 for lactation, and for related structures and functions, can not be predicted precisely, but it may be said to be of the order of 0.7 ± 0.1.

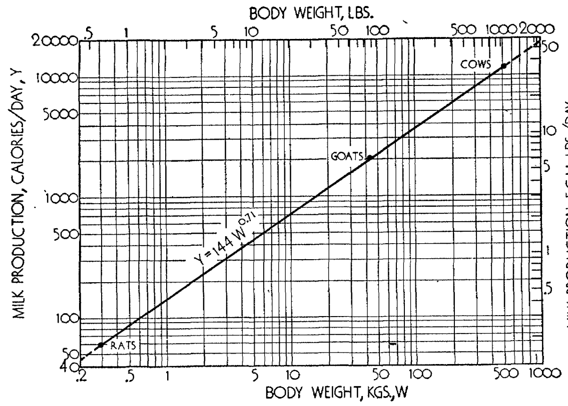

FIG. 1

The observation that *minimum* maintenance cost (basal metabolism) and milk production follow a parallel percentage course with increasing body weight suggests an economic application. If the *total* maintenance cost likewise parallels milk production with increasing body weight, the gross energetic efficiency of milk production (ratio of milk-energy produced to digestible feed-energy consumed) should be independent of body weight[2]; and if it is, the monetary profit of milk production should rise with increasing body weight because a major part of the expense of commercial milk production is for the labor of milking, feeding, cleaning, bookkeeping, housing, and so on; and such labor per animal is, within the species at any rate, practically the same whether it be relatively large or small. Hence, *within a given gross energetic-efficiency class,* the larger the animal the less the labor cost per unit milk-energy produced and, *if other conditions are equal,* the greater the profit per unit milk produced, and still greater per animal and per herd.

Unfortunately, it is not known how total maintenance cost varies with increasing body weight. It may rise more steeply than basal metabolism because the energy cost of moving the body is directly proportional to $W^{1.0}$ rather than to $W^{2/3}$. However, the voluntary movements may decline with increasing weight in such manner that the total maintenance-energy cost parallels the basal metabolism cost. Thus large animals appear to make fewer and slower movements than small, and the energy expenditure at approximately physiologically-equivalent work levels parallels the basal-metabolism energy in 1,500-pound horses, 700-pound ponies, and 150-pound men.[3] The data in Fig. 1 do not throw convincing light on the maintenance problem. The gross energetic efficiencies of milk production in the small animals in Fig. 1 were higher than in the large[4]: cows 31 per cent., goats 35 per cent., and rats 44 per cent. These differences may be fortuitous, but they may also indicate that total maintenance-energy cost rises more steeply with increasing body weight than milk-energy production, due either to selection factors or to physico-chemical inter-relations having a similar effect.

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EFFECTS OF Ca AND OTHER DIVALENT IONS ON THE ACCUMULATION OF MONOVALENT IONS BY BARLEY ROOT CELLS

THE concept of antagonism holds that Ca and other divalent cations retard the entrance of monovalent ions like K and Na into the plant cell. The experiments upon which this theory is based were, in general, performed with high and often toxic concentrations of salt on cells or roots with little regard to their metabolic status.

[2] There is no reason for assuming that it takes different amounts of feed-energy to produce unit milk-energy in, for example, 800- and 1,600-pound cows if the maintenance cost is excluded from the computations (*net* efficiency). If the maintenance item is included, the ratio of milk-energy produced to total feed-energy consumed (*gross* efficiency) is the same if the ratio of milk-energy produced to maintenance-energy is the same in large and small animals. If, however, the maintenance-energy rises more rapidly than milk production with increasing body weight, the gross efficiency decreases with increasing body weight.

[3] *Univ. Missouri Agric. Exp. Sta. Res. Bull.* 222 and 244.

[4] *Id., Res. Bull.* 285 and 291.