11659 P

Low Calcium Rickets in the Guinea Pig.*

P. R. Howe, L. G. Wesson, P. E. Boyle and S. B. Wolbach

From the Forsyth Dental Infirmary, and the Medical and Dental Schools of Harvard University.

The purpose of the present investigation was to determine if rickets could be produced in the guinea pig by diets low in calcium and low in vitamin D. This is of importance since there is a widespread belief that the guinea pig can dispense with vitamin D, perhaps by synthesizing it analogously to the synthesis of vitamin C by the rat and other animals.

No report of low calcium rickets in the guinea pig has been found. Harris[1] published a roentgenograph and a photomicrograph of a rachitic guinea pig, and, in a personal communication states that a high calcium-low phosphorus diet (Steenbock and Black) was used. Emerique[2] also reported rickets in guinea pigs, produced by a high calcium-low phosphorus diet, and that a curative effect was secured by the use of vitamin D for 7 days. No reference to tooth changes in rachitic guinea pigs has been discovered, but in rachitic dogs[3] and rats[4] the changes in developing teeth include hypoplastic defects in the enamel and a wide dentinoid border in the dentin.

Diet. Twenty-one guinea pigs weighing 166-380 gm were selected and during the experimental period were kept in a shaded room. The diet was composed of a mixture of dextrin, 71%; extracted casein, 15%; dried brewers' yeast (Harris), 6%; butter fat, 5.9%; and a calcium-free salt mixture, 2.1%. The diet was furnished in the form of a thick paste. Roughage was obtained by means of strips of filter paper. In addition, each pig received daily 10 g lettuce, 50 mg ascorbic acid, and 0.05 mg carotene.

The salt mixture is practically neutral. It contains the necessary inorganic constituents, except Ca and PO_4, in such a proportion that 2.1% will give approximately the same percentage of these constituents in the synthetic diet as 3.5% of the complete salt mix-

* Aided by a grant from the Carnegie Corporation to the University Committee on Research in Dental Medicine.

1 Harris, H. A., *Bone Growth in Health and Disease,* Oxford University Press, London, 1933.

2 Emerique, L., *Compt. rend. Acad. Sci.*, 1937, **205**, 879.

3 Mellanby, M., *Physiol. Rev.*, 1928, **8**, 545.

4 Becks, H., and Ryder, W. B., *Arch. Pathol.*, 1931, **12**, 358.

ture previously recommended.[5] Because of the sulphur and phosphorus of the casein and yeast, the diet as a whole is somewhat acid, the acidity being equivalent to about 1% H_2SO_4. The Ca and P contents of the synthetic portion of the diet are respectively 0.028% and 0.200% by analysis. The food intake varied widely both as to the individual animal and the duration of the experimental diet. If it be assumed that 20 g of the synthetic mixture were consumed

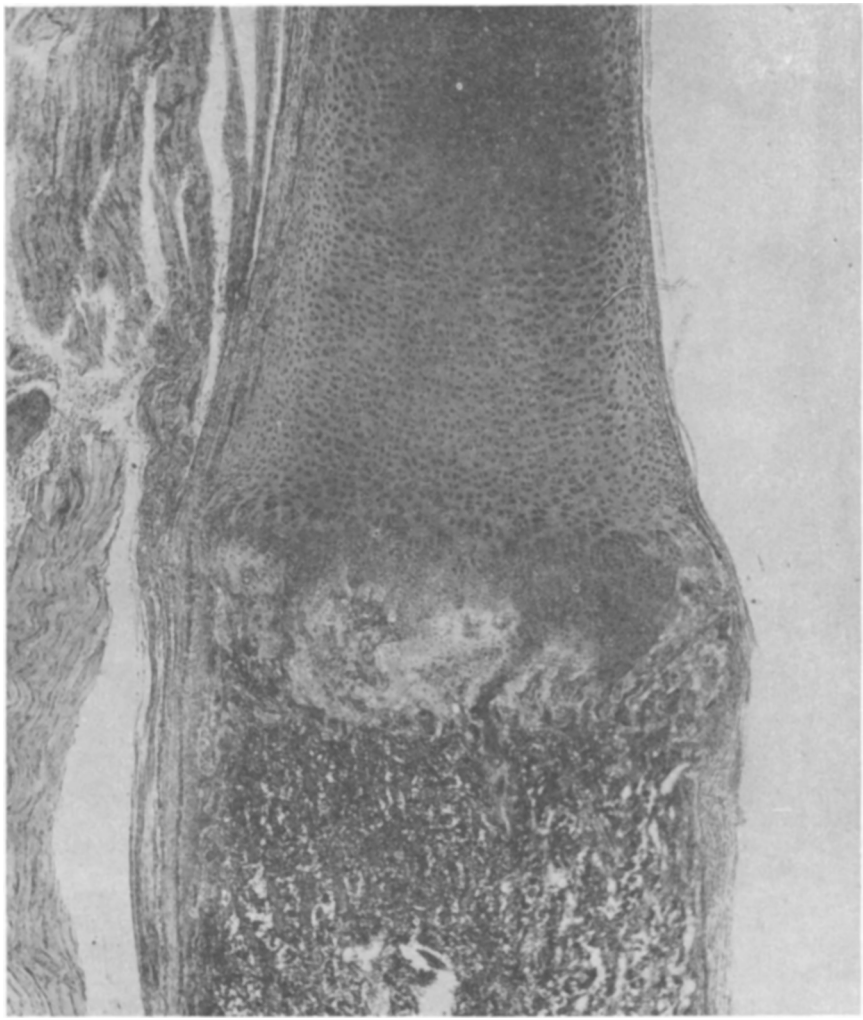

FIG. 1.

Costochondral junction of a guinea pig kept for 60 days on a low Ca, low vitamin D diet. The widening of the zone of proliferative cartilage, irregular vascular penetration and masses of osteoid tissue are characteristic of rickets. × 45.

[5] Wesson, L. G., *Science*, 1932, **75**, 339.

daily along with the 10 g portion of lettuce (1.7 mg Ca and 4.0 mg P[6]), there was a daily intake of approximately 7.3 mg Ca and 44 mg P, giving a P/Ca ratio of 6.0.

Findings. Nine animals survived from 44 to 60 days on the experimental diet, and are the subject of the present report. The body weight usually remained stationary after an initial loss until the final week or 2 weeks when, in all instances, it decreased. Widening and irregularity of the zone of cartilage proliferation at the epiphyseal lines of the long bones was most marked in the younger

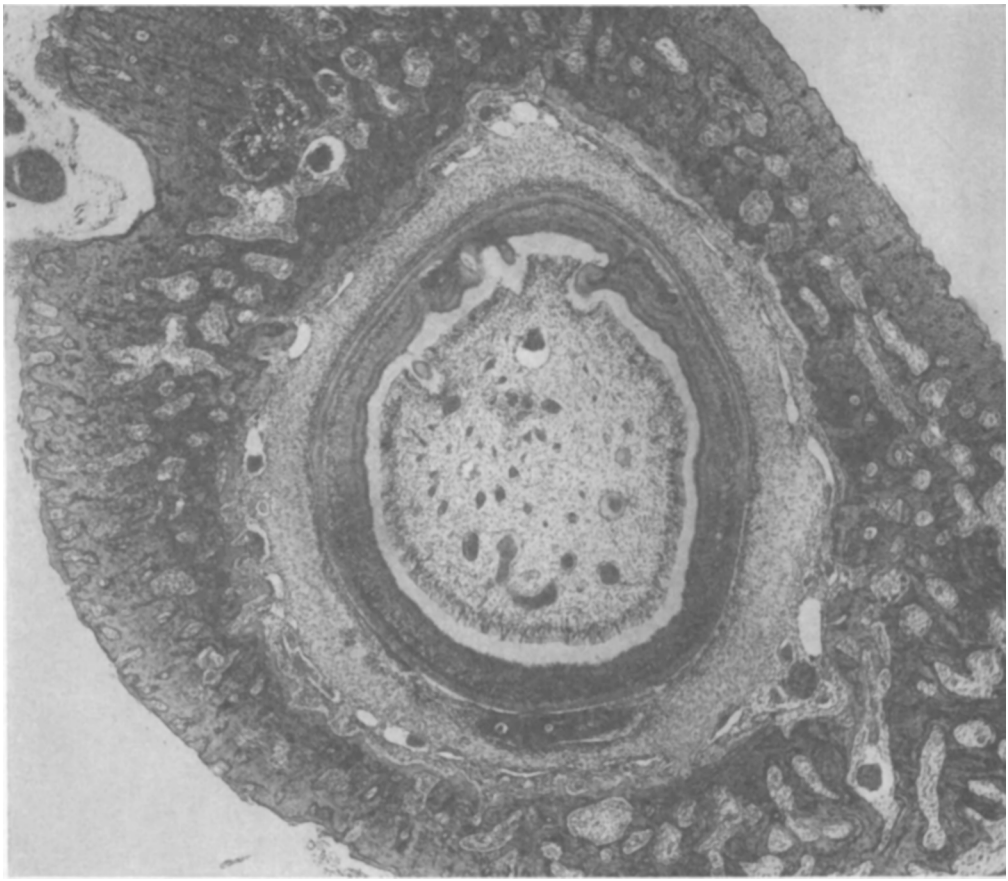

FIG. 2.

Cross section of the lower incisor tooth of the same animal cut at the level of the mental foramen. A mass of uncalcified enamel matrix may be seen on the lower mid part of the outer surface of the tooth. Almost no other enamel was present in this region. The irregularity of the calcification of the dentin and the wide uncalcified inner margin (dentinoid) are also characteristic of rickets. × 45.

[6] Sherman, H. C., *Chemistry of Food and Nutrition,* Macmillan, New York, 1937, p. 592.

animals. The number of cells in the cartilage columns was increased, and long tongues of cartilage and osteoid extended into the bony shafts. These changes were equally pronounced in the ribs (Fig. 1). In the older animals arrest of growth occurred and histological signs of rickets were thus not observed in the bones.

The teeth exhibited an extreme degree of enamel hypoplasia (Fig. 2). Areas of complete failure of enamel deposition occurred. In other areas, irregular masses of enamel matrix were found which appeared to be Ca-free since, in undecalcified sections, they did not stain with $AgNO_3$ or alizarin red S. The dentin also showed irregular calcification and a dentinoid margin 2 to 5 times normal in width. The rate of dentin deposition, as measured by intravital injections of alizarin red S,[7] was approximately half normal. Distortion of the shape of the tooth often occurred. These rachitic changes in the teeth were not affected by the arrest of skeletal growth as were the changes in the bones.

Summary. Typical rachitic changes in bones and teeth have been produced in young guinea pigs by a diet low in calcium and in vitamin D. In older animals the changes in the bones were obscured by arrested skeletal growth, but those in the teeth were constant.

11660

Convenient Electroencephalographic Electrode.

CHESTER W. DARROW. (Introduced by E. Gellhorn.)

*From the Institute of Juvenile Research and Department of Physiology, University of Illinois, Chicago.**

To make contact with the scalp for electroencephalographic recording the practice has frequently been to cut the hair in small areas and fasten electrodes in place with collodion. The collodion and the electrodes were subsequently removed with ether. The attaching of a dozen or more such electrodes for an electroencephalographic exploration is laborious, the cosmetic effect is not too favorable, and the patient may not be enthusiastic.

A more expeditious procedure for placing of electrodes on hair covered areas is possible with an electrode which makes use of the hair itself to hold the electrode. Two simple electrodes are here described. The first, illustrated in Fig. 1, consists of a ring of metal ½″ in diameter, 3/16″ high, with a wire lead attached, and a

[7] Boyle, P. E., Bessey, O. A., and Howe, P. R., *Arch. Pathol.*, 1940, **30**, 90.

* Series C, No. 313.