domain, wherein dwell some of the mysteries of matter."

S. R. WILLIAMS
FAYERWEATHER LABORATORY OF PHYSICS,
AMHERST COLLEGE

## THE PRODUCTION OF DENTAL CARIES IN RATS FED AN ADEQUATE DIET

ONE of the difficulties encountered by those who have been engaged in dental research has been the production of caries in experimental animals. In spite of the fact that diets have been fed known to be deficient in one or more of the dietary factors considered essential for normal dental development, there has been a striking absence of caries. This fact alone is impressive and suggests strongly a lack of correlation between the adequacy of the diet from a chemical point of view and the tendency of the diet to produce dental decay.

In a study made with rats on the effect of diet on dental development, we were surprised to find caries present in the normal control animals that were receiving the stock ration used in our laboratory. This ration (yellow corn 60, whole milk powder 30, linseed meal 6, alfalfa meal 3, sodium chloride 1) has given excellent results over a period of three years and is believed to be adequate for normal dental development and dental maintenance. In contrast to this, groups of rats receiving diets characterized by a high oatmeal, low calcium and low vitamin content, gave no indications whatsoever of dental decay, even though the dental structure was relatively soft. When oatmeal was substituted for cornmeal in the stock ration, caries failed to develop. Apparently, then, the cornmeal was responsible for the decay of the teeth.

In making periodic examinations of the teeth, it was observed that impactions of cornmeal particles occurred usually in the lower molars. This was followed in a few weeks by the formation of a small cavity which encouraged more impactions and subsequently more extensive decay. In many cases a complete destruction of one or more of the lower molars has been observed. The upper molars were rarely involved and then to a much lesser degree than the lowers.

The tendency for cornmeal to become impacted has been found to be primarily a function of the size of the particle. Cornmeal passing through a sixty-mesh screen appeared to have little or no tendency to become lodged in the crevices of the molars. Accordingly, when a group of rats received the stock ration containing cornmeal of this degree of fineness, there was no evidence of decay at six months. Another group receiving cornmeal that passed through a forty-mesh screen showed slight decay at three months, and at six months the crowns of the central molar teeth were destroyed. In the case of the rats which received the fairly coarse meal as supplied by a milling concern, caries was initiated at about eight weeks and at six months practically all the lower molars were involved in extensive decay.

Attempts to prevent decay of the teeth by the addition of cod-liver oil or orange juice, supplying liberal amounts of vitamins A, D and C, or by fortifying the ration with calcium carbonate or tricalcium phosphate have been of no avail. In view of these results it is difficult to accept the theory that dental caries is due primarily to a vitamin or mineral deficiency of the diet. The results rather are in strong support of a not at all modern point of view; namely, that the cause of dental decay is the decomposition, most likely by aciduric and acidogenic bacteria, of certain foodstuffs held by the teeth in some way or other.

Those who in recent years have emphasized the importance of the diet from the standpoint of vitamins and minerals as a means of preventing caries or of checking the progress of caries in human teeth have overlooked or perhaps have ignored the fact that in changing from a deficient to an adequate diet there have no doubt been marked changes effected besides the increase in vitamin and mineral content of the diet. The inclusion in the diet of greater quantities of fruits, vegetables and dairy products necessarily reduces the consumption of those foods which, because of their consistency and chemical make-up, have a tendency to be retained by the teeth and upon subsequent decomposition probably cause decay of the teeth. That the quantity of these particular foodstuffs consumed is an important factor is indicated by the fact that in a series of experiments in which various mixtures of cornmeal and oatmeal were used in compounding the stock ration a gradual increase in the frequency and severity of caries was observed as the amount of cornmeal was increased. Similar observations have been made in the case of other experimental diets in which different amounts of cornmeal were used. The increase in the diet of the so-called "protective" foods is no doubt also accompanied by a change in the physical properties of the food mixture as it exists in the mouth, resulting possibly in a marked decrease in the tendency of food to be retained by the teeth. There is also the possibility that the consumption of certain fruits, fruit juices or vegetables is accompanied by a definite cleansing of the teeth comparable perhaps to the conscientious use of a tooth brush in conjunction with an effective tooth paste.

In view of the results of the experiments described

above, it would appear desirable to give some attention in human dental studies to the physical properties of individual foods and of food mixtures with respect to their tendency for retention by the teeth. The elimination from the diet of foods that are difficult to remove from the teeth would perhaps go far in wiping out dental caries. It is also apparent from the results that a diet considered adequate merely from the chemical point of view is not necessarily a guarantee against dental decay.

C. A. HOPPERT
P. A. WEBBER
T. L. CANNIFF

DEPARTMENT OF CHEMISTRY,
MICHIGAN STATE COLLEGE

## THE EFFECT OF EPINEPHRIN-FREE SUPRARENAL EXTRACT ON THE SPECIFIC DYNAMIC ACTION OF FOODSTUFFS

IN previous publications we[1] described a new calorogenic principle obtained from the suprarenal cortex or whole gland. The active substance is combined in the lipoid fraction and can be extracted from the tissue with methyl or ethyl alcohol. After concentration of the alcoholic extract *in vacuo* at a low temperature, the active protein-free lipoid is obtained by extraction with benzene or ether. The water soluble extract of the lipoid contains epinephrin besides the active substance.[2] Epinephrin, however, is less firmly bound by the lipoid and can first be removed by prolonged washing or mild acid hydrolysis. The calorogenic principle, as we have pointed out, is unstable, but in the absence of oxygen we have found a preparation active after a period of 6 months. In our earlier work the extract was administered orally but the effects were not always constant. Given hypodermically, approximately one tenth to one fifteenth the amount is required, and the results have been much more consistent.

In our clinical work we have noted that in many cases of asthenia, including myasthenia gravis and Addison's disease, the beneficial results obtained diminished upon continued administration of the extract. Daily administration of amounts to dogs sufficient to raise the basal metabolism 40 to 50 per cent. would fail to maintain the increased metabolism after a few days. This "fading" effect upon prolonged administration of the extract has been observed in connection with the increased mechanical efficiency and disappearance of the abnormal creatine excretion in certain asthenias that we have described.

[1] A. E. Koehler, *Proc.* Soc. Exp. Biol. and Med., 26: 296, 1928; A. E. Koehler and L. Eichelberger, *Amer. Jour. Physiol.*, 90: 2, 1929.

[2] A. E. Koehler and L. Eichelberger, *Jour. Biol. Chem.*, 87: XXXVIII, 1930.

In 3 depancreatized dogs and in 3 diabetic patients we have noted that the extract decreases the sugar elimination (40 to 50 gms daily). One severe diabetic patient studied failed to show any such change. After 3 to 4 days the sugar elimination again returned to its former level even upon giving the extract.

In connection with the "fading" action we have noted a diminution or disappearance of the specific dynamic action of foodstuffs. The following results were obtained after various periods of medication. A normal control run was first obtained before treatment was started.

| Subjects studied | Cases |
|---|---|
| 0.5 gm protein gelatine (or egg white) per kilo orally | |
| S. D. A. completely eliminated | 6 |
| S. D. A. materially depressed | 3 |
| S. D. A. no change | 1 |
| 0.3 gm alanine per kilo intravenously | |
| S. D. A. eliminated | 1 |
| S. D. A. materially depressed | 2 |
| 0.5 gm glucose per kilo intravenously | |
| S. D. A. eliminated | 4 |
| S. D. A. materially depressed | 4 |

| Normal dogs | Cases |
|---|---|
| 20 gms meat per kilo | |
| S. D. A. completely eliminated | 4 |
| 2.5 gms alanine per kilo orally | |
| S. D. A. completely or nearly eliminated | 2 |
| 2.5 glucose orally | |
| S. D. A. completely eliminated | 10 |
| S. D. A. markedly depressed | 9 |

The rapidity of disappearance of the specific dynamic effect appears to be dependent upon the dosage and upon the duration of the period of medication.

ALFRED E. KOEHLER

POTTER METABOLIC CLINIC,
SANTA BARBARA COTTAGE HOSPITAL

## BOOKS RECEIVED

CAROTHERS, GLEN D. *Values and Evaluations.* Pp. 99. Pfeifer Press.

CONGER, GEORGE P. *A World of Epitomizations.* Pp. xiv + 605. Princeton University Press. $5.00.

GRAY, JAMES. *A Text-Book of Experimental Cytology.* Pp. x + 516. 205 figures. Cambridge University Press. Macmillan. $7.50.

HOLMYARD, ERIC J. *Makers of Chemistry.* Pp. xv + 314. 98 figures. Oxford University Press. $2.50.

NATIONAL RESEARCH COUNCIL. *Bulletin No. 80.* Physics of the Earth—VI. The Age of the Earth. Pp. iv + 487. National Academy of Sciences. $4.50.

PINEY, A., editor. *Recent Advances in Microscopy.* Pp. vii + 260. 83 figures. Blakiston. $3.50.

WHITE, ERROL I. *The Vertebrate Faunas of the English Eocene.* Volume I. Pp. xiv + 123. British Museum.

WISHART, G. M. *Groundwork of Biophysics.* Pp. vii + 344. 81 figures. Bell. 12/6.