occasional ventricular premature beats appeared following exposure to the rays. The irregularity was transitory but was regarded as noteworthy in that it was not observed in many other records. No other disturbances in rhythm were noted.

The form changes are not to be regarded as specific but rather as denoting alteration in the course of the excitation wave through the tissues of the heart. The significant fact is their direct relationship to radiotherapy and their association with clinical improvement. Changes of a similar order are frequently observed in rheumatic fever. Cohn and Swift, who have described them in detail, believe that they are indicative of myocardial involvement. The modification of the form of the electrocardiogram apparently associated with roentgen ray therapy suggests that an influence, presumably favorable, has been brought to bear upon the lesions in the heart muscle.

A limited number of roentgen ray treatments has been given to two patients with *Streptococcus viridans* endocarditis without evident effect either on the course of the disease or on the electrocardiogram.

### 2971

## Changes in biological value of cereal proteins due to heat treatment.

#### AGNES FAY MORGAN and FLORANCE B. KING.

### (Introduced by Carl L. A. Schmidt).

# [From the Laboratory of Household Science, the University of California, Berkeley.]

Young rats taken at weaning were fed diets constituted as follows:

Cereal, 95 per cent. Salt mixture, 3 per cent (Osborne & Mendel). Agar, 2 per cent. Cod liver oil, 25 mg. daily fed separately. Dry yeast, 0.5 gram daily fed separately. This mixture should support normal growth provided the intake is sufficient and the quantity and quality of proteins contained in the cereal are adequate. The cereals thus tested were, (1) raw cracked whole wheat, (2) cracked whole wheat cooked with excess of water, (3) cracked whole wheat toasted, (4) baker's white bread, (5) baker's white bread toasted in  $\frac{1}{4}$ -inch slices, (6) crumb of white bread, (7) crust of white bread, (8) puffed wheat, (9) shredded wheat, (10) cream of wheat, (11) puffed rice, (12) raw rice.

From four to twelve animals were kept from eight to sixteen weeks on each of these diets, with accurate food intake records. Practically normal growth was obtained upon the raw wheat, water-cooked wheat, white bread, crumb of bread, shredded wheat, cream of wheat. Raw rice gave rather less than normal growth. Very much retarded growth was obtained upon the puffed wheat, puffed rice, toasted wheat, toasted bread and crust diets. There was some variation in food intake, but growth calculated in terms of gain per gram of food, or of protein eaten, indicates definite inferiority of the latter diets.

For example, the average gains in grams of body weight per gram of protein eaten during the eight weeks of rapid growth, when the animals were four to twelve weeks of age, were as follows: toast, 1.3; bread, 1.5; cracked wheat, 1.8; puffed wheat, 0.9. No serious differences in protein content exist among these preparations. These figures are quite similar to those obtained by Osborne and Mendel<sup>1</sup> in their comparable study of the nutritive value of cereal proteins.

In order to test the theory that protein changes due to heat treatment may account for these differences, a similar number of animals were fed these same twelve diets with replacements of five per cent of cereal with purified casein. In all cases normal growth resulted. The comparable figures for the four diets mentioned above with five per cent of casein included are: toast, 2.0; bread, 2.0; cracked wheat, 1.8; puffed wheat, 1.8.

Digestibility experiments were carried out upon twenty-four of these animals in three periods of five days each in order to determine whether losses in digestion account for the differences. Although some variation was found, it was clear that this factor alone cannot account for the differences.

Comparisons of the biological value of the proteins by the

<sup>&</sup>lt;sup>1</sup> Osborne, T. B., and Mendel, L. B., J. Biol. Chem., 1920, xli, 275.

modified Thomas<sup>2</sup> procedure proposed by Mitchell<sup>3</sup> are now under way. Similar feeding experiments with isolated cereal proteins which have been heat treated, and with water-extracted cereals to eliminate the effect of possible caramel-like bodies are also under way.

### 2972

### The nature of immunity to a protozoan infection.

### I. J. KLIGLER and I. WEIZMAN.

### [From the Malaria Research Unit, Haifa, Palestine.]

In malaria infections it is a common observation that some people are more resistant than others, an observation confirmed experimentally by Celli in 1901<sup>1</sup> and more recently by Yorke and Macfie,<sup>2</sup> who showed that there are some individuals who are resistant to experimental infection.

An experimental study of this problem with malaria parasites was out of the question until the advent of the treatment of paresis by a superimposed malaria infection. We, therefore, decided to study the problem in the case of another protozoan infection, the trypanosome, which produced in experimental animals a relapsing, fatal, disease.

Our studies thus far have brought out a number of facts bearing on this problem:

(1) Acquired immunity after cure. None of the animals, rabbits or guinea pigs, used in our experiments, and the number is now fairly large, failed to become infected, or recovered spontaneously from the infection. However, animals cured of the infection with Bayer 205 acquire a resistance to reinfection quite distinct from the possible protective action due to the drug itself. These experiments have been repeated many times, with both rabbits and guinea pigs and the result is quite constant. Infected

<sup>&</sup>lt;sup>2</sup> Thomas, K., Arch. Physiol., 1909, 219.

<sup>&</sup>lt;sup>3</sup> Mitchell, H. H., J. Biol. Chem., 1924, lviii, 873.

<sup>&</sup>lt;sup>1</sup> Celli, A., Die Malaria, 1913.

<sup>&</sup>lt;sup>2</sup> Yorke, W., and Macfie, T. W. S., Trans. Soc. Trop. Med. and Hyg., 1924, xviii, 13.