

growth. Breeding sister plants together in succeeding generations causes an automatic increase of homozygosity as is well known. This being a fact, cross-sterility should increase. Such an increase in cross-sterility has been observed in the  $F_3$  and the  $F_4$  generations, but it would not be wise to maintain dogmatically that it is significant.

<sup>1</sup> Morgan, T. H., Some further experiments on self-fertilization in *Ciona*. *Biol. Bul.*, 8, 313-330 (1905).

<sup>2</sup> Morgan, T. H., *Heredity and Sex*. New York. Columbia University Press, ix + 1-282 (1913). (page cited 217).

<sup>3</sup> Fuchs, H. M., On the conditions of self-fertilization in *Ciona*. *Archiv. f. Entwickl. d. Org.*, 40, 157-204 (1914); The action of egg-secretions on the fertilizing power of sperm. *Archiv. f. Entwickl. d. Org.*, 40, 205-252 (1914).

<sup>4</sup> Jost, L., Zur Physiologie des Pollens. *Ber. d. deut. Bot. Ztg., Heft V and VI* (1907).

<sup>5</sup> Correns, C., Selbststerilität und Individualstoffe. *Festschr. d. med. nat. Gesell. zur 84. Versamml. deutsch. Naturforscher u. Ärzte. Münster i. W.*, pp. 1-32 (1912).

## THE BASAL CALORIC OUTPUT OF VEGETARIANS AS COMPARED WITH THAT OF NON-VEGETARIANS OF LIKE WEIGHT AND HEIGHT

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Among the numerous, more or less scientifically attested, facts concerning the influence of a vegetarian diet are statements relative to an observed increase in endurance and the belief that vegetarians live upon a somewhat lower metabolic plane than do flesh eaters, who, it is asserted, are unduly stimulated by the protein in their food. The measure of the basal gaseous metabolism, which may be considered as the carbon-dioxide production and oxygen consumption during complete muscular repose and in the post absorptive condition, that is, at least 12 hours after the last meal, gives an admirable index of the metabolic activity.

We have been able to make observations on the basal gaseous metabolism of 11 men and 11 women, who had subsisted upon a vegetarian diet for a considerable period of time, extending, on the average, over several years. With the subjects in the post absorptive condition and lying quietly upon a comfortable couch, the total carbon-dioxide production and oxygen consumption of each of these individuals were measured on several days by means of the universal respiration apparatus. As a rule the values obtained agree well with each other and the averages

may be looked upon as reasonably accurate indices of the actual basal metabolism from which the energy output may be computed.

In order to study particularly the influence of a vegetarian diet, it was necessary to compare these values for vegetarians with those obtained on non-vegetarians of the same height and weight. A sufficiently large number of observations on non-vegetarians, including both men and women, was available for a satisfactory comparison of this kind. The body weights of the men ranged from 75 kg. to 49.3 kg. and of the women from 93.6 kg. to 40.0 kg. A comparison of the heat production per 24 hours as computed from the gaseous exchange showed that the men vegetarians produced 25.5 calories per kilogram and the non-vegetarian men of like height and weight 26.4 calories. On the commonly used, yet questionable, basis of the heat per square meter of body surface per 24 hours the vegetarians showed 798 calories as compared with 828 calories for the non-vegetarians. With the women the corresponding values per kilogram of body weight were 24.6 calories for the vegetarians and 25.0 calories for the non-vegetarians; and per square meter of body surface 753 calories for the vegetarians compared with 766 calories for the non-vegetarians.

Believing that the relatively large proportion of carbohydrate supposedly eaten in the vegetarian diets might tend to a larger storage of body glycogen, thus giving available carbohydrate material to be drawn upon in the endurance and similar tests of muscular efficiency, a computation was made in all cases of the respiratory quotient, i.e., the relationship between the carbon-dioxide production and oxygen consumption. When the katabolism is exclusively from carbohydrate this quotient is 1.0; with pure fat it is 0.70. For the 22 vegetarians (11 men and 11 women) the average quotient was found to be 0.83 while the average for the 132 non-vegetarians (77 men and 55 women) it was 0.81. The mathematical difference between these average respiratory quotients is too slight to be taken as evidence of a larger glycogen storage.

The results show, therefore, that the gaseous metabolic processes of the vegetarians are qualitatively and quantitatively essentially those of non-vegetarians of similar height and weight with whom they are compared.

The detailed report of this study has been transmitted to the *Journal of Biological Chemistry*.