DR. WILHELM STEINHAUSEN, of the University of Frankfort, has been appointed to the chair of physiology at the University of Greifswald.

DISCUSSION AND CORRESPONDENCE

DOES THE AMOUNT OF FOOD CONSUMED INFLUENCE THE GROWTH OF AN ANIMAL?

UNDER the above title H. H. Mitchell[1] has recently published a general criticism of certain types of nutrition studies. In the course of his argument he refers to several papers from this laboratory (without specifically naming the authors) as illustrations of what he says appear "to represent an exaggeration of the importance of negative experimental results." In this category he places our findings that arginine and histidine are not interchangeable in metabolism.[2,3] His objection to our conclusions appears to be due to the fact that the animals which received arginine in the absence of histidine ingested less food than those which received histidine in the absence of arginine. We are convinced that the diminished food consumption of the arginine animals was *the result of the dietary inadequacy.* Such evidence as is available indicates the correctness of this conception. Sixteen years ago F. G. Hopkins[4] pointed out that when a deficiency occurs, the failure in appetite *follows* the failure in growth; which was interpreted by him as indicating that the latter is the *causal* factor, and the diminished food consumption merely the *result* of the inhibited synthetic processes. He says, "If then a factor or factors essential to growth be missing from, or deficient in, a dietary, the consequent arrest of, or diminution in, growth energy may diminish the instinctive consumption of food, while the supply of such factors may increase consumption as an indirect result of a direct effect upon growth." A similar conclusion was reached by Osborne and Mendel[5] in a study of the supplementing influence of yeast upon artificial diets. They state, "The food consumption of the rats on the smaller quantities of yeast was less than that of those on the larger quantities, because their growth was slower and consequently they needed less food; and the change from a small quantity of yeast to a larger one was followed by growth with a resultant increase in food intake."

The above quotations show clearly that the investigators in question regard the diminished food consumption of animals on inadequate diets as the *result* of the failure in growth. No one will deny that, within certain limits, an animal which ingests a liberal amount of an *adequate* food will increase in weight more rapidly than one which consumes a smaller quantity, but this fact is not incompatible with the mass of evidence which has been accumulated, indicating that the ability or inability of an animal to grow upon a given diet exerts a profound influence upon food consumption.[6] Indeed, so generally is this correlation observed that Osborne and Mendel[7] remarked several years ago, "It is a common experience that animals living on unsuitable diets tend to reduce their food intake." Evidently, therefore, the conclusions in our arginine-histidine experiments were arrived at by application of exactly the same principles employed by others in proving dietary deficiencies.

Acceptance of the doctrine that in a young animal growth is an indication of dietary adequacy, and failure of growth a characteristic having the converse significance, is regarded by Mitchell as evidence of amazing credulity since it involves, he says, belief in "the infallibility of the animal appetite." The writer doubts whether any one believes that appetite is infallible. The use by the human subject of various materials which do not contribute to nutritive well-being is quite sufficient to exclude such a view should one be disposed to adopt it. Appetite is a more or less imperfect (and therefore not infallible) response to a physiological need, but when an added dietary component leads to an appetite stimulation the explanation is to be found, we believe, in *the influence exerted by the substance upon the cells themselves.* In the words of Hopkins,[4] "any effect of the addendum upon appetite must have been secondary to a more direct effect upon growth processes." *Thus our view places the emphasis upon the cell processes* rather than upon the imperfect outward manifestations. It recognizes the fundamental and irrefutable fact that the animal organism is unerringly accurate in its syntheses. If a tissue is to be formed at all, every component required must be available or capable of being manufactured by the cells; otherwise the synthesis will not occur. If growth follows the

[1] Mitchell, H. H., SCIENCE, 1927, lxvi (December 16), 596.

[2] Rose, W. C., and Cox, G. J., *J. Biol. Chem.*, 1924, lxi, 747.

[3] Rose, W. C., and Cox, G. J., *J. Biol. Chem.*, 1926, lxviii, 217.

[4] Hopkins, F. G., *J. Physiol.*, 1912, xliv, 425.

[5] Osborne, T. B., and Mendel, L. B., *J. Biol. Chem.*, 1917, xxxi, 149.

[6] A few of the many contributions showing this fact, and involving both vitamine and amino acid deficiencies are, Osborne and Mendel, *J. Biol. Chem.*, 1915, xx, 351, and 1916, xxv, 1; Karr, *ibid.*, 1920, xliv, 255; Cowgill, *Am. J. Physiol.*, 1921, lvii, 420; and Jackson, *J. Biol. Chem.*, 1927, lxxiii, 523.

[7] Osborne, T. B., and Mendel, L. B., *J. Biol. Chem.*, 1920–21, xlv, 277.

addition of an essential constituent to an inadequate diet, it does so because cell reactions which could not proceed in the absence of the added factor are now made possible. We believe that as the growth syntheses occur, the demand for raw materials is reflected in a stimulation of the appetite resulting in greater food consumption. It is difficult to see why such a view is unreasonable, or necessitates great gullibility for its acceptance. Furthermore, if food intake is not influenced by the adequacy of the ration it is a remarkable coincidence that of our histidine- and arginine-fed rats not a single one inadvertently made the mistake of eating more or less food than the other members of its group.

Mitchell also criticises in a similar fashion several papers dealing with the possibility of replacing essential amino acids (cystine and histidine) with synthetic compounds. It is scarcely necessary to defend these papers, inasmuch as no experimental data have been adduced indicating that our findings are incorrect. Suffice it to say that we are still of the opinion that taurine is "totally incapable" of replacing cystine in the diet for purposes of growth,[8] nor do we know of any reason for abandoning the conclusions expressed in the original publications regarding the availability of synthetic imidazoles.[9]

Mitchell cites the work of Lewis and Root[10] upon the replacement of lysine by nor-leucine as an example of a properly conducted experiment, in which the alterations in food consumption inherent in our investigations do not occur. If one calculates the average daily food consumption of Lewis and Root's rats, as may be done readily from the information supplied in the paper, it becomes evident immediately that *the foods were not consumed in equal amounts.* On the contrary, as would be expected, the change from an inadequate (gliadin) to an adequate (gliadin plus lysine) diet *was followed invariably by an increase in average daily food consumption. Supplementing gliadin with nor-leucine led to no appreciable change in food intake because both rations were equally inadequate for growth.* Furthermore, it must not be forgotten that gliadin contains some lysine. Were it completely devoid of this amino acid, the addition of the latter would lead to even greater alterations in food consumption than those observed. The experiments of Lewis and Root are comparable to our taurine investigations, in which the basal diet was not completely devoid of cystine. The magnitude of the changes in food consumption is of the same order in the two studies. There can be no reasonable doubt of the correctness of Lewis and Root's conclusions regarding the inability of nor-leucine to replace lysine, but the implication of Mitchell that there were no alterations in food consumption with the different types of diets is not in accord with the facts.

[8] Rose, W. C., and Huddlestun, B. T., *J. Biol. Chem.*, 1926, lxix, 599.

[9] Cox, G. J., and Rose, W. C., *J. Biol. Chem.*, 1926, lxviii, 781.

[10] Lewis, H. B., and Root, L. E., *J. Biol. Chem.*, 1920, xliii, 79.

WM. C. ROSE
LABORATORY OF PHYSIOLOGICAL CHEMISTRY,
UNIVERSITY OF ILLINOIS

THE SIBERIAN METEORITE

IN view of recent newspaper reports regarding a great meteorite supposed to have fallen in Siberia, I am sending you the following rather free translation of Mr. L. Kulik's story as it originally appeared in Russian.

From the two newspaper articles by Mr. L. Kulik, which you gave me, I have been able to obtain the following information concerning the so-called "Tungusk meteorite."

The appearance at 7 o'clock in the morning on June 30, 1908, of a "fiery body" of unusual brightness, rolling across the sky out of the north east and falling down in the "taiga" between the Yenissei and Lena Rivers, north of the Railroad line, was observed by a great number of people, mostly the native inhabitants, living in the basins of these rivers.

The fall of the meteorite was instantly followed by a column of fire rising skyward, by the formation of the heavy black clouds, and by a most deafening, resounding noise far surpassing in its magnitude, any thunderstorm, or artillery cannonade. This was heard for hundreds of kilometers within a radius of the cities of Yenisseisk, Krasnoyarsk, Kansk, Nijneudinsk, and Kirensk on Lena.

A terrific air-wave was formed which pushed ahead everything that it met in its way. The water in all rivers, lakes and streams was raised up; people and animals were lifted by it and carried along.

The vibrations produced by the fall of the meteorite were detected and registered by the seismographs of the Physical Observatory at Irkutsk, where Mr. A. V. Vesnesenski, who was in charge of the observatory, calculated the epicenter of the "earthquake" to be located in the upper part of the Podkamennaya Tunguska.

The phenomenon produced considerable panic, especially among the natives living in the basins of the Yenissei and all the various Tunguska Rivers, and adjacent part of the Lena River basin.

Several attempts, made in 1908, to find the body of the meteorite were fruitless, as for some reason all parties were searching near the city of Kansk, and not in the locality, determined by A. V. Vesnesenski, whose observations unfortunately remained unpublished. Gradually interest in the new meteorite died, and the whole matter was almost forgotten, except as a tale among the natives.