

by serum or protein, a property essential for their use as internal antiseptics. The degree of bactericidal effect obtained depends not only upon the chemical nature of the compound but also upon the organism employed for the test. Comparative experiments with different bacterial species and with different varieties of the same species have demonstrated in many instances remarkable specificity. One class of substances, for example, killed *B. typhosus* in a dilution of 1 to 200 in two hours, whereas, in the same time it killed streptococcus in dilutions of 1 to 50,000 or more. The toxicity of the substances varies naturally with the character of the group added to the hexamethylenetetramine molecule.

A further study of the bactericidal properties of methyleneamino compounds in general is now in progress. A detailed description of the chemical and bacteriological work will follow in the appropriate journals.

## CHEMICAL AND PHYSIOLOGICAL STUDIES OF A MAN FASTING THIRTY-ONE DAYS

By Francis G. Benedict

NUTRITION LABORATORY, CARNEGIE INSTITUTION OF WASHINGTON

Presented to the Academy, March 9, 1915

The important relationship between numerous diseases and the various stages of nutrition and the fact that many pathological cases border on complete or nearly complete inanition make a study of the physiology and chemistry of normal fasting of special importance to the physiologist and the clinician alike. It is rarely practicable to make exhaustive and simultaneous observations in several physiological and chemical fields of study with a subject undergoing a prolonged fast but the arrival in Boston in 1912 of a Maltese, A. Levanzin, who wished particularly to fast thirty-one days under strict scientific observation, presented such an opportunity. It was thus possible to supplement earlier data secured with men during relatively short periods of fasting (2 to 7 days) in the chemical laboratory of Wesleyan University. (Benedict, Carnegie Institution of Washington Publication No. 77, 1907.)

In accordance with a previously arranged program and in coöperation not only with the entire scientific and computing staff of the Nutrition Laboratory but with several members of the faculty of the Harvard Medical School, an extensive study of this man was made. The experiment began April 14, 1912, with a preliminary period of three days with food, followed by thirty-one days of complete abstinence from

food and drink other than distilled water, and finally a three-day re-orientation period. In all save the last period the experiment was most successful.

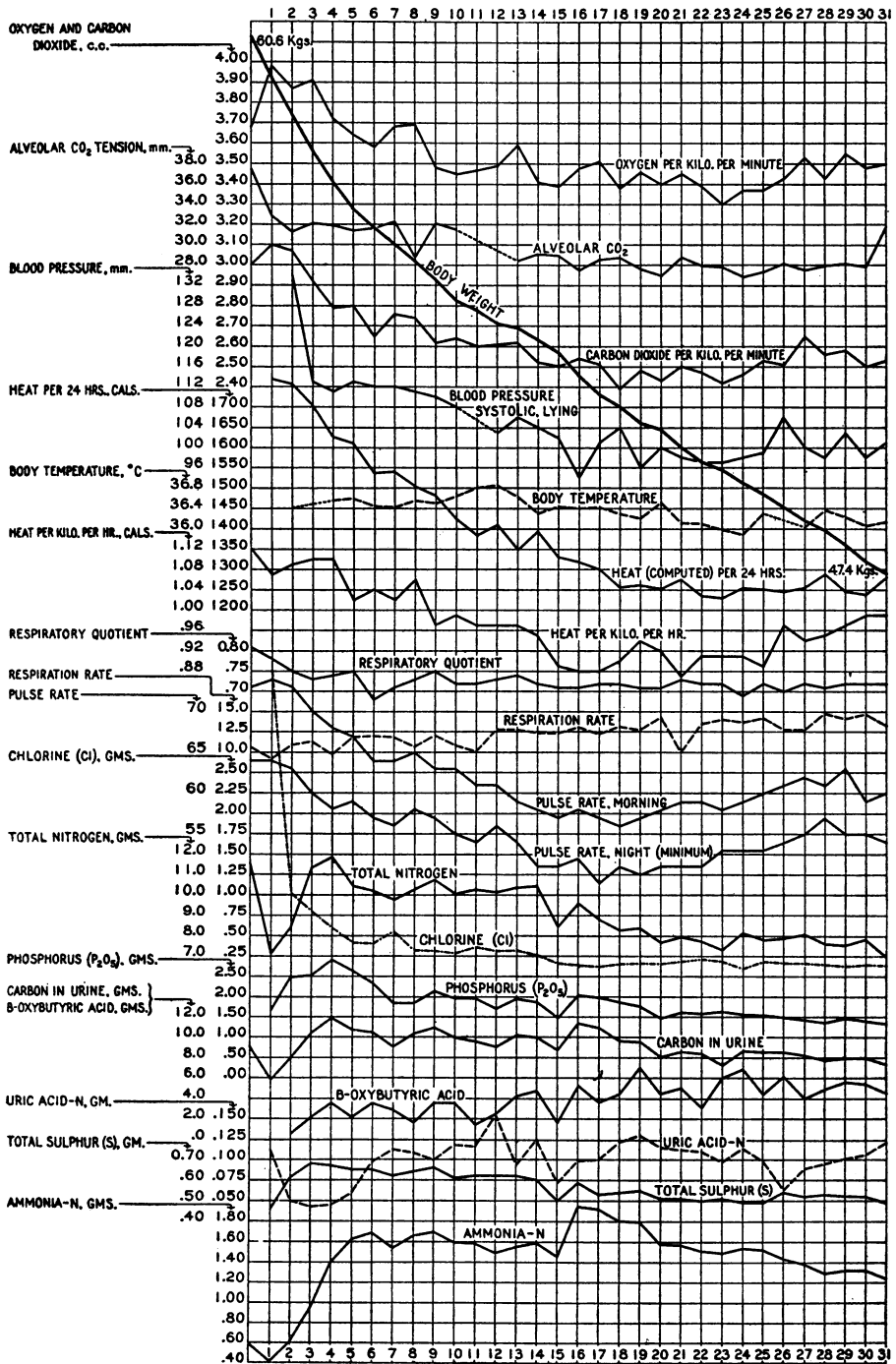
Measurements were made of the body-weight, insensible perspiration, rectal temperature fluctuations, pulse-rate, blood pressure, and the morphology of the blood. The mechanics of respiration and the alveolar air tension were also observed. A complete clinical examination was made every second day with a record of subjective impressions and psycho-physiological observations. The intestinal flora were studied and the skin excretion determined. A complete chemical examination was also made of the urine, including the partition of the nitrogen and the determinations of the chlorine, phosphorus, sulphur, total acidity, and B-oxybutyric acid. The mineral constituents, particularly the calcium, magnesium, sodium, and potassium excretion, were studied and the reducing power, the carbon, and the energy of the urine were determined. Throughout the fast the urine was examined daily with a microscope and tested for albumin. Of special significance was the study of the respiratory exchange, both with the universal respiration apparatus and with the large bed respiration calorimeter.

In the respiration calorimeter it was possible to measure simultaneously the carbon-dioxide excretion, the oxygen consumption, and the water vaporized from the lungs and skin. Direct heat measurements were likewise made which, when corrected for body temperature fluctuations, gave the exact heat production. From the results obtained with the respiration apparatus the effect of various factors upon the metabolism was studied, such as changes in the body position, the work of writing, and breathing oxygen-rich atmospheres. The metabolism of the subject during sleep was also compared with his metabolism in the waking condition. The energy transformation per kilogram of body weight and per square meter of body surface was computed. From the numerous respiration experiments with both apparatus and a careful record of daily activity, the total balance of income and outgo for this man for the thirty-one days could be computed with great accuracy.

Of special clinical importance are the records of the losses in weight; the studies of the rectal temperature, blood pressure and blood; the acidosis induced by the fast; and the effect of the fasting upon the composition of the urine and the respiratory exchange. The psychological studies and the general observations of the man showed that for thirty-one days the subject was able to exist in a fairly normal mental condition, entirely out of proportion to the physical decline in the body functions. The ill-advised insistence of the subject led to his breaking the fast by

# METABOLISM CHART OF A MAN FASTING 31 DAYS

APRIL 14 - MAY 15, 1912



the selection of excessive amounts of acid fruit juices, thus inducing a most distressing colic and intestinal disorder; a short sojourn at a hospital was followed by convalescence.

It is impossible in the space available in these Proceedings to attempt an adequate summary of the results but the accompanying chart indicates the trend of some of the most important factors measured. The detailed results of the research are incorporated in a 416-page monograph issued as Publication No. 203 of the Carnegie Institution of Washington.

## THE STUDY OF INDIAN MUSIC

By Alice C. Fletcher

PEABODY MUSEUM, HARVARD UNIVERSITY

Presented to the Academy, March 2, 1915

Thirty-five years of acquaintance with Indian music gathered from tribes of different linguistic families widely scattered over North America and a study, still in progress, of the music of a particular group has revealed facts relative to their music and its uses that possess an anthropologic value.

The term music as applied to the Indian refers solely to vocal music; for the natives of America possess few varieties of musical instruments beside the drum and rattle, both of which are used mainly to accent time and rhythm.

The number of Indian songs which have come to my personal attention number many hundreds. Those to which intensive study is being given have been secured from people classed as Plains Indians. All of these songs have been examined under their native conditions and in connection with the ceremonies, secular or religious, of which they were a part. When I began to observe and gather Indian songs, the graphophone was not available for field work. Securing songs by dictation was a difficult and unsatisfactory task for the reason that the Indians so frequently were averse to repeating the songs under observation, particularly when they were religious in character. This obstacle has been entirely overcome by the use of the graphophone, as one singing will give a record that can be repeated any number of times for the purposes of transcription, verification, and other study. For over twenty-five years I have used the graphophone when engaged in the field study of native ceremonies containing rituals and songs.

The word 'song' to our ears, suggests words arranged in metrical form and adapted to be 'set to music,' as we say. The native word