

Dr. A. J. Carlson and the Concept of Hunger

By FREDERICK HOELZEL*

THE DEATH of Dr. A. J. Carlson (Sept. 2, 1956) appears to have left his personal experience of hunger in the absence of gastric "hunger" contractions unpublished. In his published explanations,^{1,2} Carlson, like Cannon, attributed hunger to the periodic "hunger" contractions of the fasting stomach and this explanation is usually referred to by others. However, in discussing the subject with me in 1917, Carlson revealed that, during a period in 1914 after a fast of about 5 days, he experienced unquestionable hunger with food in his stomach and therefore hunger without gastric "hunger" contractions. He felt certain that this was *hunger* and not the desire to eat which he regarded to be *appetite*. He said, however, that he was unable to explain this experience of hunger. Obviously, it was not explainable on the basis of his (and Cannon's) previously published concept of hunger. The lack of confirmatory and objective evidence at that time as to its being hunger and not appetite, presumably explains why Carlson did not report this observation when he reported the other findings concerning his five-day fast and the after-effects.^{2,3}

However, he agreed that his experience of hunger independent of gastric "hunger" contractions would have been explainable on the basis of my concept of hunger. I believed that normal hunger was more or less directly related to the need of food⁴ and that the nature of normal hunger was best indicated by the effect and after-effect of prolonged fasting. I had already fasted as long as 26 days in 1913 and my impression was that the reference of hunger to the stomach had decreased or tended to disappear after about the fifth day. I therefore thought that Carlson,

by fasting only about five days, had not fasted long enough to note this. Carlson said that he believed that differences of opinion should be settled by experiment and I therefore volunteered to fast for about two weeks for a study of hunger to settle our differences.

To pursue this study I fasted 15 days in the summer of 1917, but observations on hunger and the fasting gastric motility and secretion were made daily for an additional eight weeks during which time I lived in Carlson's laboratory. The results failed to change our ideas about hunger. During a control week of observations before I began fasting, I was greatly impressed by the close correlation which usually existed between the recorded gastric "hunger" contractions and the desire to eat that was referable to the stomach. But it was obvious to me that this desire to eat was the "stomach craving" which in his book Fletcher⁵ had designated as "false appetite," and which he had advised should be ignored because it did not reflect the need of food. That is, the desire to eat which I experienced when the gastric "hunger" contractions occurred in the morning could easily be ignored. During the afternoon, the desire to eat increased and became more and more imperative without a corresponding increase in the recorded "hunger" contractions. I was then following my usual previous practice of eating all of my food late in the day, or trying to wait for a normal appetite to develop before eating, as suggested by Fletcher. Filling the stomach once with food did not satisfy me, or left me still feeling hungry but without room for more food immediately. I practically always felt impelled to eat more food before I retired. In short, I then had the daily experience of hunger with food in the stomach and without "hunger" contractions as in Carlson's experience after his five-day fast, but the similarity of our experiences was not recognized then. Instead,

* Assistant to the late Dr. A. J. Carlson at the Department of Physiology, University of Chicago.

Present address: 6659 S. Stewart Ave., Chicago 21, Illinois.

Carlson considered my failure to be satisfied with a normal quantity of food to be evidence of bulimia.⁴

The observations made during my 15-day fast were regarded by Carlson as supporting his published concept of hunger. The periodic gastric "hunger" contractions and accompanying sensations were manifested throughout the fast.⁴ The desire to eat was not as clearly related to the "hunger" contractions after the first few days as previously, but Carlson attributed the change in sensations to a depression of my appetite, as the recorded "hunger" contractions did not diminish. He previously explained a similar change in sensations during his five-day fast in the same way. According to my analysis however the change in sensations simply indicated that the desire to eat (hunger) was not directly related to the "hunger" contractions. My later studies also made it obvious that the use of an inflated balloon in the stomach to record the contractions had increased the gastric sensations and apparently also the "hunger" contractions, although they undoubtedly occur periodically throughout much more prolonged fasting.⁶

Observations made after the 15-day fast at Carlson's laboratory revealed some other discrepancies between the recorded gastric "hunger" contractions and the desire to eat. Some recorded "hunger" contractions were not felt while some epigastric hunger sensations were noted when no gastric "hunger" contractions were manifested. In fact, there seemed to be two or more types of epigastric hunger sensations and I believed that the keenest of these was produced by the acid gastric secretion. This was more clearly indicated in a later study.⁷ However, there were times when the correspondence between the recorded "hunger" contractions and the desire to eat seemed to be perfect or normal and I realized that a more satisfactory explanation of hunger than that of Carlson and Cannon would have to take this apparently normal correlation into consideration.

In 1924, I found that the gastric "hunger" contractions occurred without any accompanying desire to eat when my stomach became empty after having eaten a very large amount

of easily digested and rapidly absorbed food. In fact, by regulating the time and amount of eating, I found it possible to experience hunger with the stomach full of food in the morning, and satiety with periods of "hunger" contractions of the fasting stomach in the evening. Thus, a close dependence of the urge or desire to eat (hunger) upon at least some central (central nervous system or blood) need of food was clearly indicated. It consequently became obvious that my "bulimia" or previous tendency to overeat was due to my attempt to satisfy myself by stuffing my stomach instead of regulating my eating so as to satisfy central needs. Since then, I have found it much easier to avoid overeating or even reduce weight by eating most of my food relatively early in the day instead of late in the day or after some degree of fasting, as in 1917.

Carlson was satisfied with the evidence that the gastric "hunger" contractions could occur without being accompanied by any desire to eat. Actually, my finding only represented the result that might have been expected in making observations under more extreme conditions than those under which Carlson previously found that the desire or urge to eat was not as great during the first periods of "hunger" contractions following a meal as during subsequent periods.² My aim then was to report my findings by writing a book on hunger and appetite. Carlson offered to help me find a publisher if I did so. However, the manuscript I prepared was not regarded as satisfactory by Carlson. This and other considerations made it seem advisable that there should first be a study of some of the still unsolved problems associated with hunger. After publication of three reports of pertinent studies,⁷⁻⁹ I prepared a report of my findings in 1924 and this was accepted by Carlson for publication without hesitation.¹⁰

Cannon, in a letter addressed to Carlson, complained about Carlson "allowing" the publication of this paper. Cannon thought that I failed to distinguish between hunger and appetite. In my opinion neither Cannon nor Carlson ever distinguished clearly between hunger and appetite. They never showed that the desire to eat, which they regarded to be appetite, was absent when the desire to eat,



which they considered to be hunger, was manifested. According to my view, there was only one kind of desire to eat and this varied in intensity and was or was not associated with gastric or other sensations. Carlson discussed the subject further with me before he replied to Cannon. Carlson still thought that he could distinguish between two drives or desires to eat and to this extent he continued to agree with Cannon. But to justify his sponsorship of the publication of my paper, he stated only that he did not believe that the publication of differing views should be prevented. With my approval, he sent along my written comments on Cannon's criticism which I had addressed to him (Carlson) while I happened to be away from the laboratory.

Carlson invited me to present my views or comments at two scientific meetings where hunger was discussed, but otherwise he referred only to his published explanations. However, he eventually had occasion to regret not having supported my concept of hunger more actively. This happened when his opinion was requested of a paper on hunger and appetite that had been submitted for publication in *Physiological Reviews* or the *Journal of Applied Physiology*. Carlson's explanation of hunger was severely criticized in this paper and there was no reference to my paper on central factors in hunger. Carlson was greatly upset because of the source of this paper. When he discussed it with me, I told him that he should have supported my view of hunger more actively. His only response to this was, "I know, I know." Carlson seemed to want to be credited at least with having recognized the value of my findings and conclusions. The paper was apparently rejected for publication in the form submitted because of Carlson's objections to it. I had expected my findings and conclusions to be confirmed by others in some ways much sooner as most of Carlson's associates and students who gave hunger special attention were not satisfied with his (and Cannon's) explanation of hunger and appetite.

Carlson and I agreed that hunger persisted throughout prolonged fasting and we published joint comments on that subject,⁶ but I declined an invitation to join him in preparing a re-

quested revision of Cannon's article on hunger and thirst for a new edition of the *Encyclopaedia Britannica*.

Although Carlson did not publish a revision of the explanation of hunger published in 1916, the foregoing should make it clear that he did not rigidly adhere to his published views. Carlson certainly did not consider hunger to be simple gastric pain as implied by Janowitz and Grossman.¹¹ In nearly 40 years of association with Carlson, my impression always was that he regarded the essential element in hunger to be a keen desire, urge, or impulse to eat. Carlson's emphasis on the gastric sensations in hunger was obviously a consequence of using an inflated balloon in the stomach to obtain data on gastric motility. Although hunger can be experienced without gastric contractions and evidently even without a stomach, there seems to be no justification for a change in the definition of hunger such as Janowitz and Grossman suggested. They regarded the desire to eat to be appetite and based on learning, but evidence that the desire to eat is learned is lacking. I have indicated how the terms "hunger" and "appetite" can be applied to different factors affecting the food intake without the confusion involved in the explanations of Cannon and Carlson and without departing unjustifiably from their definitions.^{12,13}

The discovery of Cannon's student, Washburn, and the independent discovery of Carlson that the common reference of hunger to the stomach is explainable by periodic contractions of the fasting stomach were significant contributions to our understanding of one factor that influences our food intake, but the inferences or speculations of Cannon and Carlson that were based on this discovery created a prolonged confusion. The more recent studies of others¹⁴ have not helped very much to clarify the subject or to show how hunger and appetite can be controlled. An understanding of hunger and/or appetite depends partly on information obtained by introspection and there is need for more self-studies by investigators, such as those of Carlson and myself. Studies made on others, on infants or animals, largely yield only information "about it and about".



REFERENCES

1. CARLSON, A. J.: The relation between the contractions of the empty stomach and the sensation of hunger. *Am. J. Physiol.* 31: 175, 1913.
2. CARLSON, A. J.: *The Control of Hunger in Health and Disease*. The University of Chicago Press, Chicago, 1916.
3. CARLSON, A. J.: The hunger contractions of the empty stomach during prolonged starvation. *Am. J. Physiol.* 33: 95, 1914.
4. CARLSON, A. J.: Hunger, appetite and gastric juice secretion in man during prolonged fasting (fifteen days). *Am. J. Physiol.* 45: 120, 1918.
5. FLETCHER, H.: *The A.B.-Z. of Our Own Nutrition*. F. A. Stokes, New York, 1903.
6. CARLSON, A. J., and HOELZEL, F.: The alleged disappearance of hunger during starvation. *Science* 115: 526, 1952.
7. HOELZEL, F., and KLEITMAN, N.: Some conditions affecting subjective and objective manifestations of hunger. *Arch. Int. Med.* 39: 710, 1927.
8. HOELZEL, F.: The relation between the secretory and motor activity in the fasting stomach (man). *Am. J. Physiol.* 73: 463, 1925.
9. HOELZEL, F.: The effect of variations in the protein intake on the acidity of the secretion of the fasting stomach. *Am. J. Physiol.* 77: 166, 1926.
10. HOELZEL, F.: Central factors in hunger. *Am. J. Physiol.* 82: 665, 1927.
11. JANOWITZ, H. D., and GROSSMAN, M. I.: Hunger and appetite: Some definitions and concepts. *J. Mt. Sinai Hosp.* 16: 231, 1949.
12. HOELZEL, F.: The determinants of the food intake. *Am. J. Digest. Dis.* 18: 96, 1951.
13. HOELZEL, F.: *A Devotion to Nutrition*. Vantage Press, New York, 1954.
14. HOLLANDER, F. (Ed.): Conference on the Regulation of Hunger and Appetite. *Ann. N. Y. Acad. Sc.* 63: 1-144, 1955.

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