than the impulses of the other end. With a strip showing these reactions it is possible to repeat all of the phenomena that can be obtained from a mammalian heart in block produced by compression of the auriculoventricular bundle.

These facts suggest the following theory of heart-block: Clamping the auriculoventricular bundle reduces the efficiency of the cardiac impulses that reach the ventricles. With a certain degree of pressure the impulses become subminimal with respect to the irritability of the ventricles. Such an impulse therefore fails to elicit a contraction of the ventricles. The next following auricular impulse is no stronger than the preceding one, but in the interval the irritability of the ventricles has increased to the extent that the weakened auricular impulse then acts as an efficient stimulus. In this state of affairs the rhythm would be 2:1. A further reduction in the efficiency of the auricular impulse would give higher degrees of partial block and finally complete block. With this theory as a basis it becomes possible to explain all of the important phenomena of heart-block.

29 (121). **"On the nature of the reflexes controlling the successive movements in the mechanism of deglutition": S. J. MELTZER.**

The entire act of deglutition consists of a series of consecutive movements beginning with the elevation of the mylohyoid muscle of the floor of the mouth, progressing through pharynx and esophagus and terminating with the contraction of the cardia at the entrance of the stomach. The progress of these movements is surprisingly well regulated and stable. Each section of this canal enters into the peristaltic movement invariably at a given interval after the beginning of the swallowing. The time allowed for the entire course differs with each species of animal; it is about 7 seconds for the human being, about four seconds for the dog, and about 2 seconds for the rabbit.

It was early recognized that these stable relations were under the control of a reflex mechanism. That the contractions could not be caused by a direct stimulation of the muscle coat of the esophagus by the passing food was proved by the fact that there is no peristalsis when the vagi are cut. In a series of experiments

carried out by Ludwig and Wild at about the middle of the last century, it was found that ligation or transverse section of the esophagus prevents the further progress of the peristalsis to the lower segment. They drew the conclusion that the reflex is of a local nature, that is, that the food or drink while passing the esophagus sends up from each transversed section a sensory impulse which causes a reflex contraction of that section. Some twenty-five years later, however, A. Mosso made similar experiments and obtained opposite results; namely, that after ligating, transverse cutting, and even after removing a whole ring of the esophagus, the peristalsis once begun would appear also in the lower end of the esophagus. Similar observations were made by Kronecker and the author about 25 years ago on the cardia of rabbits. Even after removal of a large part of the esophagus the cardia would contract in due time after the beginning of swallowing. These experiments seem to permit only one conclusion, namely, that there are no local reflexes, that is, that the food while passing the esophagus does not send up sensory impulses to the center of deglutition, but that there is only one sensory impulse sent up at the beginning of the act of deglutition which spreads slowly within the center and sends down consecutively motor impulses to the successive sections of the deglutition path.

A few years ago the author reinvestigated the subject. There was a direct contradiction in point of fact between Ludwig and Wild on one hand, and Mosso and Kronecker and the author on the other; it seemed strange that Ludwig, the master physiologist, should have failed to see what appeared so easy to observe. An analysis of the methods employed in both series of investigations led to discovery of the reason for the discrepancy in the results. The animals of Ludwig and Wild were in deep anesthesia during the experiments, while those of Mosso were out of the anesthesia again, and the animals of the author's experiments were only under slight anesthesia. The author tested this point on a few animals and found the surmise correct. When the animals were in deep anesthesia no peristalsis passed beneath a ligature, while it ran down the entire esophagus as soon as the animals were out of the anesthesia. This means that in normal animals the process of deglutition is carried out by a reflex with only one initial sensory

impulse, the impulse traveling further within the center, while in anesthetized animals the progress of the peristalsis is furthered by a chain of local reflexes.

On reinvestigating this problem the author recently found that this chain of local reflexes exists also in the normal, non-anesthetized animals when ordinary stimulation is avoided. The experiments were made on rabbits. A cannula was tied in the upper end of the esophagus. When any indifferent liquid was injected directly into the esophagus, instead of being introduced by way of the mouth, a peristaltic wave ran down the esophagus, terminating in a contraction of the cardia just as after a normal deglutition. When the esophagus was ligated the wave stopped at the ligature. This happened whether the animal was deeply anesthetized or was awake. That the wave of peristalsis was a reflex phenomenon, and not simply due to the mechanical effect of the injections was proved by cutting the vagi. In this case the injections simply filled up the esophagus without causing any peristaltic waves or any contractions of the cardia. Better than cutting was the painting of the vagi with cocain or with magnesium sulfate. In these cases the nerves could be restored by irrigation and the experiment repeated many times. A similar wave of peristalsis was obtained when the liquid was injected through the cardia upward through a catheter. The peristalsis began at a point just above the highest drop of liquid. The wave always ran towards the stomach and against the stream, even if the animal was kept head downward. The peristaltic wave could also be produced by merely injecting air into the esophagus either from above or from below. This explains a fact which the author recorded 23 years ago, namely, that each act of "belching" is followed by a peristaltic wave of the esophagus.

The author found that this chain of local reflexes is very resistant to ether anesthesia; it disappears at about the same time that the lid reflex is abolished, and returns as soon as the ether is discontinued.

The experiments demonstrate that the function of deglutition is provided with two sets of reflex mechanisms. One mechanism has only one initial afferent impulse which travels within the center independently of any further aid from the esophagus; it is very sensitive to anesthesia and we may call it a higher reflex. The

other is a lower reflex, consisting of a chain of local reflexes which are very resistant to anesthesia.

The complexity of their mutual relations furnishes suggestive problems for future investigations.

30 (122). **"The enzymes of inflammatory exudates. A study of the enzymes concerned in inflammation and their relation to various types of phagocytic cells": EUGENE L. OPIE.**

The leucocytes of an inflammatory exudate produced by injecting aleuronat into the pleural cavities of dogs digest protein both in an alkaline and in an acid medium (uncoagulable protein nitrogen being estimated by the Kjeldahl method). The following evidence shows that two enzymes are present:

(*a*) Cells, dried after treatment with absolute alcohol and ether and then reduced to a powder, digest actively in an alkaline medium (0.2 per cent. sodium carbonate), but have almost completely lost the power of digesting in an acid medium (0.2 per cent. acetic acid).

(*b*) By subjecting washed cells of a sterile inflammatory exudate to varying degrees of heat, their power to digest in an alkaline and in an acid medium is lost at a temperature above 70° C. At temperatures between 55° and 65° C. the power to digest in an alkaline medium is unimpaired but in an acid medium it is much diminished.

(*c*) With cells of exudate removed from the pleural cavity twenty-four hours after the injection of aleuronat, digestion is very active in an alkaline medium, but less active in an acid medium. At the end of from three to five days, power of digesting in an alkaline medium is diminished or unchanged, but the acid digesting power is increased.

At the end of twenty-four hours after injection of aleuronat polynuclear leucocytes with fine granulation are predominant and from 85 to 90 per cent of the cells are present. The cells, according to observations previously reported, contain a ferment with acts in an alkaline medium. At a later stage of inflammation when large mononuclear phagocytic cells are predominant, the power of digesting in an acid medium is increased and bears a relation to the proportion of mononuclear phagocytes. If washed red