In this investigation rabbits weighing about 1,500 grams were used and the salts chiefly employed were sodium sulfate and sodium phosphate. Sodium sulfate, in 4 per cent. and 25 per cent. solutions, when injected subcutaneously in 15 c.c. doses, caused no purgation in any of the experiments. Five or six hours after an injection, the feces that were passed often weighed less than five grams and were of normal consistence and form. Only rarely did the total 24-hour fecal output exceed 15 grams and the pellets were moderately hard, dry and well formed. Similar results were obtained when 4.5 per cent. sodium phosphate, in 15 c.c. doses, was injected subcutaneously. Both salts failed to cause purgation but induced a moderate degree of constipation.

The action of sodium sulfate and sodium phosphate on intestinal peristalsis was also studied. The intestines of rabbits anesthetized by morphin were observed with and without a saline bath. The subcutaneous injection of sodium sulfate and sodium phosphate caused a definite increase in the pendular motions of the small gut, especially of the duodenum. These movements, however, were not of a character to cause the evacuation of unformed feces, an impression which was confirmed by the results already reported. Increased intestinal movements and purgation are therefore by no means synonymous terms; the two may possibly even be independent of each other. Leubuscher,[1] for instance, found that 5–10 grams of sodium sulfate or magnesium sulfate injected into the stomach of rabbits produced in the majority of cases no increase in the frequency or intensity of peristalsis.

The experiments which have been briefly reported lead to the conclusions first, that the subcutaneous injection of sodium sulfate or sodium phosphate does not produce purgation in rabbits, and secondly, that the pendular movements of the small gut are moderately increased thereby.

28 (120). **"The effects of extra stimuli upon the heart in the several stages of block, together with a theory of heart-block": JOSEPH ERLANGER.** (Presented by **S. J. MELTZER.**)

This research was undertaken with the object primarily of testing the statement made by Hering that the absence of a compen-

[1] Leubuscher: *Virchow's Archiv*, 1886, civ, p. 104.

satory pause following an extra stimulation of the ventricles of the warm-blooded heart suffices to prove that the ventricles are beating independently of the auricles.

The author's experiments on the dog's heart have shown that in partial, as well as in complete heart-block, extra systoles of the ventricles are not followed by compensatory pauses. This results from the tendency for the same number of auricular beats to elapse between the extra contraction and the next following natural contraction as intervene between two natural ventricular beats in any stage of partial block. The following may be taken as an average example: If the auriculoventricular rhythm is 3:1, a ventricular extra cycle will last through any part of such auricular cycle as may have been unfinished at the moment of stimulation, plus two more auricular cycles if more than one half of the first auricular cycle was unfinished, or plus three or more auricular cycles if less than half of the first auricular cycle was unfinished.

In partial heart-block extra systoles of the auricules do not cause contractions of the ventricles excepting, occasionally, when such extra systoles fall close to the end of a ventricular cycle; and extra contractions of the ventricles never cause contractions of the auricles.

The irritability of the ventricles in partial and complete heart-block is not reduced but rather it is increased over that which obtains in the normal heart. Furthermore, in each ventricular cycle of partial and complete heart-block the irritability of the ventricles probably increases until they pass into the refractory state which develops with their contraction.

In order to determine the significance of these results, a strip of terrapin ventricle was arranged so that rhythmic stimuli as well as extra stimuli could be thrown into either end as desired. The strip was suspended over a Gaskell clamp in such a way that the impulses passing through the strip could be blocked either partially or completely at its middle. In many such experiments it was found that when the strip would beat normally, apparently, from end to end in one direction, a partial or complete block would sometimes be unmasked when the strip was made to beat in the opposite direction. Such behavior is undoubtedly due to the fact that the impulses generated in one end of the strip are more efficient

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