The latter effect is quite peculiar, however. The tetanus lasts only a short time, no matter how long or brief the stimulation may be. Moreover, the effect cannot be obtained by a second stimulation unless quite a long interval passes between the stimuli.

(Some of the above mentioned facts were demonstrated on an animal with destroyed cord.)

31 (174)

Deglutition through an esophagus partly deprived of its muscularis, with demonstration.

By **S. J. MELTZER.**

[*From the Rockefeller Institute for Medical Research.*]

As a result of the experiments which Kronecker and I carried out about twenty-seven years ago, it appeared to be conclusively established that liquids are squirted down into the esophagus by the force of the contractions of the mylohyoid muscles and some muscles of the tongue, and that liquid thus projected reaches the cardia long before the arrival of the peristaltic wave. At that time the experiments were carried out on a human esophagus. About ten years ago in a series of experiments on the dog I found that our contention held good also for that animal. Cannon and Moser, however, who studied the esophagus by the fluoroscopic method, although confirming our conclusions for the human being, state that "in the dog and cat but little variation was seen in the swallowing of liquids and solids." Recently Schreiber stated that even in the human being, liquids, just like solids, are not squirted down but are carried by the muscles of the mouth and tongue to the pharynx, whence they are conveyed further into the esophagus by the contractions of the constrictors of the pharynx and are finally transported into the stomach by the peristaltic movements of the esophagus. In other words, liquids are also slowly pushed forward through every section of the path of deglutition by the contraction of the muscle fibers of that section; there is no part of that long path through which liquids are thrown or squirted.

I do not intend to enter into an analysis of the experiments and arguments upon which Schreiber founded his views. The object of

my communication was to demonstrate *a dog drinking in a perfectly normal manner, although a large section of its path of deglutition was deprived of all muscle fibers.* In a number of dogs I have completely removed the muscularis from the entire cervical esophagus. Already on the next day after the operation they drank milk and water like normal dogs. In these cases there were no muscle fibers for quite a long distance to do the slow work of pushing the liquids into the thoracic esophagus. They were apparently squirted through the cervical esophagus by a muscular force located anteriorly to the esophagus. That this force is not due to the constrictors of the pharynx was demonstrated by another experiment. In one dog, besides the removal of the esophageal muscularis, the middle and lower constrictors of the pharynx were cut and completely put out of function. This dog, also, drank without any difficulty the day after the operation. The throwing force is apparently exercised by the muscles of the mouth and tongue.

I wish to call attention to another point. Recently again it was claimed that liquids go down the esophagus by the force of gravity. No experiments were offered in proof of that contention but it had the support of the authority of Von Mickulicz. In my demonstration the bowl of milk was placed on the floor and the large dogs that had been operated on drank from it against gravity without any difficulty.

I would call attention to another matter which has been overlooked by some writers. We have established the fact, and it is easily demonstrated, that each act of swallowing inhibits the peristalsis relating to the preceding deglutition, and when swallows follow one another at intervals of one second there is no peristalsis in the esophagus until after the last swallow. Dogs drink very rapidly, and can take 200 c.c. and more without stopping. Where then is the peristalsis even in normal dogs to carry down such a large quantity of liquid? Does the latter simply accumulate in the pharynx and the upper part of the esophagus until the last swallow?

Finally I wish to say that the essential part of our problem is the *establishment of the theory as it was originated by Kronecker, viz., that besides the slow transportation of food by peristalsis, the function of deglutition is provided with a mechanism for a rapid squirting down of appropriate materials.* As to which of the mechanisms

comes into play in any specific case depends upon the nature of the material which is swallowed. We said that *liquid* is squirted down, but I am quite sure that thick syrup is not squirted farther than the upper part of the esophagus, if so far. We said that semi-liquids or semi-solids are also thrown down. We came to this conclusion from observations made on the swallowing of bread thoroughly softened in water. Possibly in this case a separation took place and the water was thrown down while the bread or some of it stuck to the wall of the gullet and was later gathered up by the peristalsis. It is not improbable that this is what occurs when a mixture of bismuth and water is swallowed. The water may be squirted down, while a large part of the bismuth may stick to the wall and be gathered up later by the succeeding peristalsis — and it is the latter which is probably seen through the fluoroscope.

32 (175)

Immunity against trypanosomes.

By **F. G. NOVY.**

[*From the Hygienic Laboratory of the University of Michigan.*]

It is an establised fact that rats which have recovered from an infection with *Tr. Lewisi* are immune to subsequent inoculation with that species of flagellate. The same holds true for cattle, sheep, goats, etc., that have recovered from the infection caused by the pathogenic trypanosomes, such as nagana, surra and dourine. This condition of active immunity is seemingly possible only in those species of animals that are relatively insusceptible, for with really susceptible species the infection is always fatal.

Heretofore all experiments on artificial immunity against trypanosomes have been made on animals that have recovered from the effects of the parasite which has been living and multiplying in the blood-vessels of that animal. Now that cultures of some of these organisms, as for example *Tr. Lewisi* of the rat and *Tr. brucei* of nagana, are possible it was desirable to ascertain whether or not they could be used to immunize against the virulent organisms. It may be said, in passing, that cultures of both of these trypanosomes, even after they have passed through a hundred generations or subcultures in the course of two years, do not be-