and bronchiolitis, both endo- and peri-, and severe acute emphysema. A typical finding was large and small mononuclear cell infiltration of subepithelial stroma and of tissues surrounding some bronchi and many bronchioles. Consolidation of the lungs was not found. No inclusion bodies were found. Although we recovered *H. pertussis* from bronchi and bronchioles, we failed to demonstrate to our complete satisfaction *H. pertussis*-like organisms embedded in the cilia.

7227 P

Inhibition of Cardiac Accelerator Impulses by the Carotid Sinus.*

D. W. BRONK, L. K. FERGUSON† AND D. Y. SOLANDT.‡

From the Eldridge Reeves Johnson Foundation for Medical Physics, University of Pennsylvania.

It has been shown by Hering,[1] Heymans,[2] and others that stimulation of the afferent endings in the carotid sinus by an increase in the endosinusal pressure causes a slowing of the heart. Some have held that this is entirely due to a reflex stimulation of vagal fibers while others have presented evidence to show that there is a reflex inhibition of the cardiac accelerators as well. The second explanation involving a reciprocal mechanism has generally appeared to be the more probable. In the present investigation we have studied certain aspects of this reflex by observing the sympathetic impulses to the heart while varying the pressure in the carotid sinus.

The experiments were performed on cats under nembutal anesthesia. The carotid sinus on each side was isolated and perfused by way of the common carotid and external carotid arteries. Inasmuch as the nerve supply remained intact an increase of pressure within the sinus caused an increase in the number of afferent impulses going to the medullary centers.[3] The effect of these impulses on the cardiac accelerator discharge was determined by record-

* The expenses of this research have been in part defrayed by a grant from the Committee on Scientific Research of the American Medical Association.

† Associate in Surgery.

‡ Research associate, University of Toronto.

1 Hering, H. E., *Die Karotissinusreflexe.* Dresden, T. Steinkopff, 1927.

2 Heymans, C., Bouckaert, J. J., and Regniers, P. *Le Sinus Carotidien.* Paris. G. Doin, 1933.

3 Bronk, D. W., and Stella, G., *J. Cell. and Comp. Physiol.*, 1932, **1**, 1.

ing with a vacuum tube amplifier and oscillograph the sympathetic impulses in one of the small nerves running from the stellate ganglion to the heart.

The general nature of the cardiac sympathetic activity has been described[4] as a persistent tonic discharge of impulses grouped into large waves. We now find that as the pressure within the sinus is raised this discharge decreases until at about 125 to 150 mm. Hg. there is a complete inhibition of the sympathetic impulses.

If the pressure within the sinus be maintained at such a level the period of complete inhibition lasts for some seconds, after which there is an escape with a return of the sympathetic discharge. The duration of this period of inhibition is a function of the endosinusal pressure. In one experiment it was 1 second at a pressure of 140 mm. Hg. and increased to 5 seconds at 300 mm. Hg. The escape may be due to adaptation of the endings in the sinus or to some process of adaptation in the centers. This latter explanation seems more probable because the pressure endings in the carotid sinus adapt slowly and relatively little, but a definite conclusion must wait on further experiments.

It is generally stated that the slowing of the heart caused by an increased pressure in the carotid sinus is due to a unilateral reflex. Such an opinion is founded on experiments which showed no decrease in heart rate when the vagus, on the side of the sinus which was stimulated, was cut, even though the other vagus was intact. Our experiments, on the other hand, indicate that the reflex inhibition of accelerator tone is bilateral. Distension of either carotid sinus produces inhibition of the cardiac sympathetic impulses from both stellate ganglia.

In keeping with this fact is our finding that the duration of the sympathetic inhibition resulting from the simultaneous distension of both carotid sinuses is equal to the sum of the periods of inhibition resulting from the distension of each sinus separately. There is very definite evidence of summation.

The duration of accelerator inhibition resulting from a given degree of carotid sinus stimulation is often increased by section of both aortic nerves. This fact is related to Hering's observation that one carotid sinus is more effective in lowering blood pressure if the other sinus is denervated and the aortic nerves are cut.

[4] Bronk, D. W., and Ferguson, L. K., PROC. SOC. EXP. BIOL. AND MED., 1932, **30**, 339.