

Ringer's *in vivo* are difficult to determine because the "high-light" is reflected from the surface of the added fluid and not from the cilia. When particles are present, however, they can be followed. Their movement becomes more rapid after the aqueous solution is added, which agrees with Hill's observation¹⁰ that the removal of mucus and addition of Ringer's solution greatly increases the rate of movement of particles in the excised trachea.

The results have demonstrated that the cilia of the frog's pharynx in the absence of extraneous factors maintain an inactive quiescent state, that with mechanical stimulation due to movements of the eyes or prodding with an instrument or addition of inert particles or derangement of the mucous layer, the cilia are stimulated to activity which ceases when the cause is removed. Therefore, the base line for physiological studies of ciliary behavior *in vivo* and even *in vitro* is zero for the frog's pharynx and not some value obtained from the rate of particle movement over the surface, nor after the surface has been washed with Ringer's solution. Thus it is evident that the effects on ciliary activity reported for many drugs, solutions, gases, et cetera, have been learned from an epithelium which was already acting under the influence of one or more stimuli and it may be that some of those agents which are said to have no effect on ciliary movement may act as a stimulant when the normal base line of activity is taken at zero.

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Nature and Function of Certain Fibers of the Vagus—A New
Concept in Peripheral Nerve Organization.

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An analysis of the vagus nerves of the cat and turtle (Heinbecker¹) demonstrated 3 distinguishable potential complexes. The first had physiological properties characteristic of somatic nerve fibers, the other 2 had properties of a much slower order, properties which our subsequent investigations have associated with autonomic motor functions. A correlation between potential form and

¹⁰ Hill, L., *Lancet*, 1928, **215**, 802.

¹ Heinbecker, P., *Am. J. Physiol.*, 1930, **93**, 284.

nerve fiber type as revealed in osmicated cross sections of nerve indicates that the first potential complex is derived from larger myelinated fibers, the second from small thinly myelinated fibers and the third from non-myelinated fibers.

Experiments have been performed on the cat in which stimulating and recording electrodes were placed on the central portion of one cervical vagus nerve in an animal in which both nerves were cut. The potential record of the nerve was observed coincidentally with the physiological effects in the animal resulting from electrical stimulation. The afferent fibers whose activity is responsible for respiratory and vascular reflex effects are found to fall in the group giving rise to the first potential complex. No further effects are elicited by stimuli strong enough to excite the fibers giving rise to the second and third potential complexes.

The vagus nerve above the nodose ganglion was sectioned in cats and after sufficient time for degeneration the vagus nerve trunk in the neck was studied functionally. In such preparations adequate stimuli failed to cause slowing of the heart rate, but normal results from the fibers responsible for certain motor effects in the lungs and duodenum were still obtained.

Section of vagus roots at their exit from the brain stem after sufficient time for degeneration had a similar effect, indicating that the fibers responsible for slowing of the heart rate have their cells of origin within the central nervous system.

Experiments in normal animals in this and previous work (Heinbecker²) have established the fact that vagus efferent fibers to the heart, lungs and intestine are non-myelinated. These and further studies, histological and functional, have shown that the cells of origin for such fibers motor to the lungs and intestine, unlike those to the heart, have their cells of origin in the nodose ganglion. *They have a central and a peripheral process and no evidence of a synaptic junction in this pathway through the nodose ganglion is demonstrable.* Still further experiments have excluded the possibility of the fibers in question being sympathetic in origin.

These experimental results establish the fact that in the vagus nerve motor fibers exist whose cells of origin lie outside the central nervous system. Heinbecker, O'Leary and Bishop³ have shown that unmyelinated fibers with physiological properties similar to those of unmyelinated motor vagus fibers have their cells of origin

² Heinbecker, P., *Am. J. Physiol.*, 1931, **98**, 220.

³ Heinbecker, P., O'Leary, James, and Bishop, George H., in press.

in the spinal ganglia and these are the fibers which upon stimulation cause vasodilatation. It has been customary to characterize the activity of such fibers in the dorsal roots as antidromic. Inasmuch as such an explanation could not possibly be applied to similar fibers of the vagus nerve, the existence of true antidromic effects is questioned. Our findings would seem to impose a limitation on the general applicability of the Bell-Magendie hypothesis with regard to the nature of fibers whose cells of origin are in ganglia, other than sympathetic, outside the central nervous system.

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Further Evidence of the Virus Nature of Interstitial Bronchopneumonia.

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Interstitial bronchopneumonia in man is a characteristic feature in 3 epidemic diseases, measles, epidemic influenza, and whooping cough. In an experimental study of the pneumonia produced by vaccine virus, Muckenfuss and I¹ have shown that the interstitial tissue of bronchial and alveolar walls is thickened by an infiltration of mononuclear cells. In this respect vaccine virus pneumonia resembles interstitial bronchopneumonia in man, although the experimental lesion is not complete, because it lacks the exudate of polymorphonuclear leucocytes and fibrin commonly found in the lumen of the affected bronchi and surrounding alveoli. We have described² a method of reproducing the typical interstitial bronchopneumonia, as seen in man, by injecting vaccine virus into the lungs of animals and introducing, a day or 2 later, into the same animals, a suspension of pyogenic bacteria. The results strongly suggest that interstitial bronchopneumonia is the result of the combined action of a virus and bacteria; the virus producing the interstitial cellular infiltration and the bacteria calling forth the acute inflammatory exudate in the bronchus and neighboring alveoli.

Of the 3 human diseases associated with interstitial bronchopneumonia, measles is the only one now generally accepted as a virus

¹ Muckenfuss, R. S., McCordock, H. A., and Harter, J. S., *Am. J. Path.*, 1932, **8**, 63.

² McCordock, H. A., and Muckenfuss, R. S., *Am. J. Path.*, March, 1933, **9**.