TABLE II.
Latent Period After Digitoxin.

Frog	Control latent period	Strength digitoxin × 1000	Latent periods (milliseconds) 1	2	3	4	5	6	7
A	12	1:100	12	12	15				
C	13	"	10	11	14	18			
D	5	"	7	14	14	15			
E	11	"	11	11	11	16	17		
G	10	1:50	11	12	14	13	17		
M	9	"	12	13	13	13	14	17	
N	11	"	12	12					
O	9	"	12	13	13	13	14	17	
H	10	1:25	11	13	14	14	15		
I	11	"	11	11	10	11	12	15	17
J	10	"	10	10	10	12			
L	9	"	10	12	13	12	14		
Mean value	10		10.7	12	12.8	13.7	14.7	16.3	17
Mean time (min.) after immersion	29.8	33.4	59.9	81.7	107.3	126.5	137.2	140.	155.

strate that the latent periods remained constant both when compared with each other and over the total time period. Table II summarizes the results of the determinations of latent periods of 12 similar isolated gastrocnemius preparations in which digitoxin of varying strengths was used as a bath material immediately following a preliminary control latent period determination. Following immersion in the saline bath the preliminary latent period determinations were made after a mean time of 29.8 minutes and the muscle was immersed in digitoxin solution at a mean time of 33.4 minutes. The mean value of the preliminary latent period control of 10.0 milliseconds in this group compares favorably with that of 10.7 milliseconds for the initial latent period of the saline control series presented in Table I. The prolongation of the latent periods of isolated frog gastrocnemius muscles immersed in digitoxin solution can be seen in Table II in which the mean latent period values progressively increase with time from the first mean value after addition of digitoxin of 10.7 milliseconds to the final 17.0 milliseconds. From this data it is evident that after digitoxin was added the duration of latent period increased while that of the control remained relatively constant.

Summary. Digitoxin solution applied by immersion technic prolongs the latent period of isolated frog gastrocnemius muscle.

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Anatomy of the Thoracic Vagus in the Dog and a Technic for Its Interruption.* (17770)

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Preparatory to observing the role of the vagus nerve in the genesis of peptic ulcer produced experimentally in dogs by cincophen(1), it was mandatory to have a procedure which would free the stomach from vagus nerve supply. It has been established(2) that the

1. Hilsabeck, J. R., and Hill, F. C., PROC. SOC. EXP. BIOL. AND MED., 1947, v66, 155.

2. Hartzell, J. B., *Am. J. Physiol.*, 1929, v91, 161.

stomach of the dog is vagally denervated only when bilateral vagotomy is performed supradiaphragmatically but we were unable to find an adequate description of the technic involved. In addition, the course of the nerve in the thorax as given by various authors (3-5) was not detailed enough to serve as a basis for such a procedure. Consequently, it was necessary to observe the course of the vagi in a significant number of dogs and, from these observations, to devise an operative procedure, applicable to any dog, which would insure disruption of the thoracic vagi at a level between the hilus of the lung and the diaphragm.

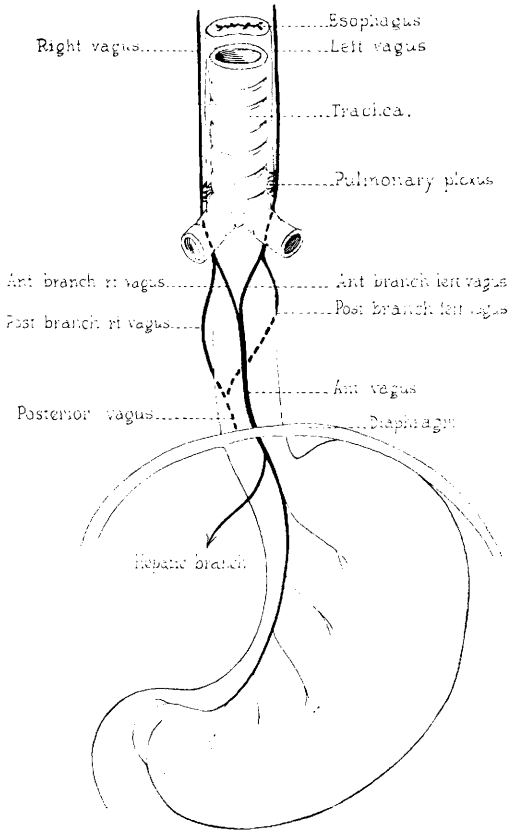

FIG. 1.

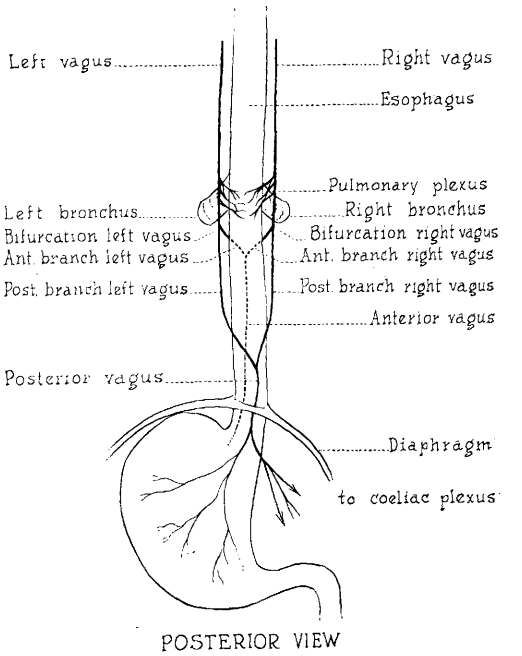

FIG. 2.
Schema of the thoracic vagi in the dog.

Since there is often a demand for a dog with the vagi disrupted transthoracically below the level of the hilus of the lung but above the diaphragm, it was felt that our findings, as well as a description of the surgical technic evolved, would be of value to experimental workers especially in view of the paucity of such information in the literature.

Anatomical Course of the Vagus Nerve in the Thorax of the Dog. After observing the course of the vagus nerves in the thoraces of 42 dogs coming to autopsy for various reasons, it was apparent, in contrast to man (6,7), that both nerves pursued a constant course (Fig. 1 and 2) deviating from the normal only in diameter of the branches. The typical description, which follows, was taken from the autopsy protocol of one of the animals. In this dog the course of the vagus nerve was easily demonstrated in the thorax and neck. The ribs were cut away, the nerves dissected black India ink applied to the vagi along with the phrenic nerves, and photographs taken to

3. Jemerin, E. E., and Hollander, F., PROC. SOC. EXP. BIOL. AND MED., 1938, v38, 139.

4. McCrea, E. D., *J. Anat.*, 1924, v59, 18.

5. Bradley, O. C., *Topographical Anatomy of the Dog*, Macmillan Company, New York, 1927.

6. Bradley, W. F., Small, J. T., Wilson, J. W., and Walters, W., *J.A.M.A.*, 1947, v133, 459.

7. Miller, E. M., and Davis, C. B., Jr., *J.A.M.A.*, 1947, v133, 461.

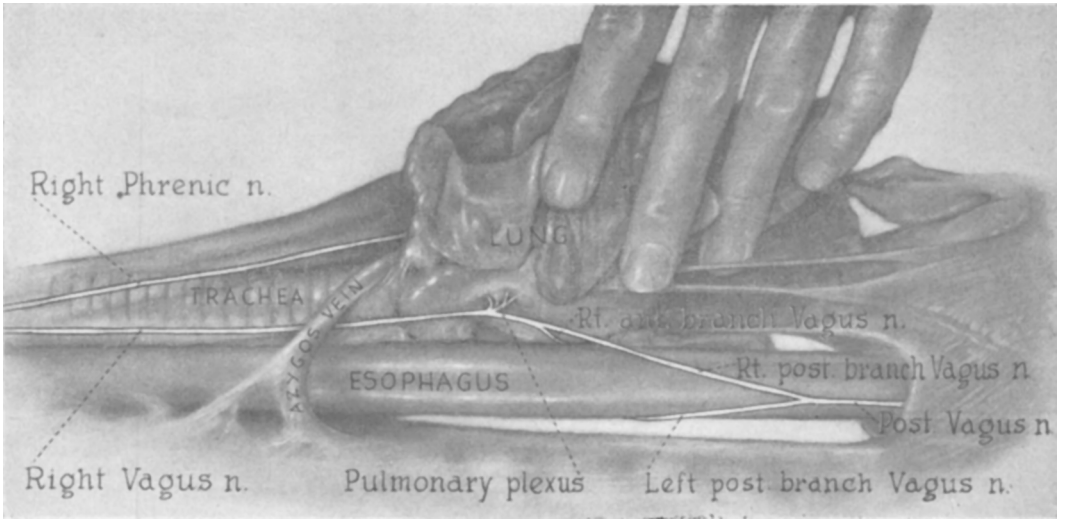

FIG. 3.

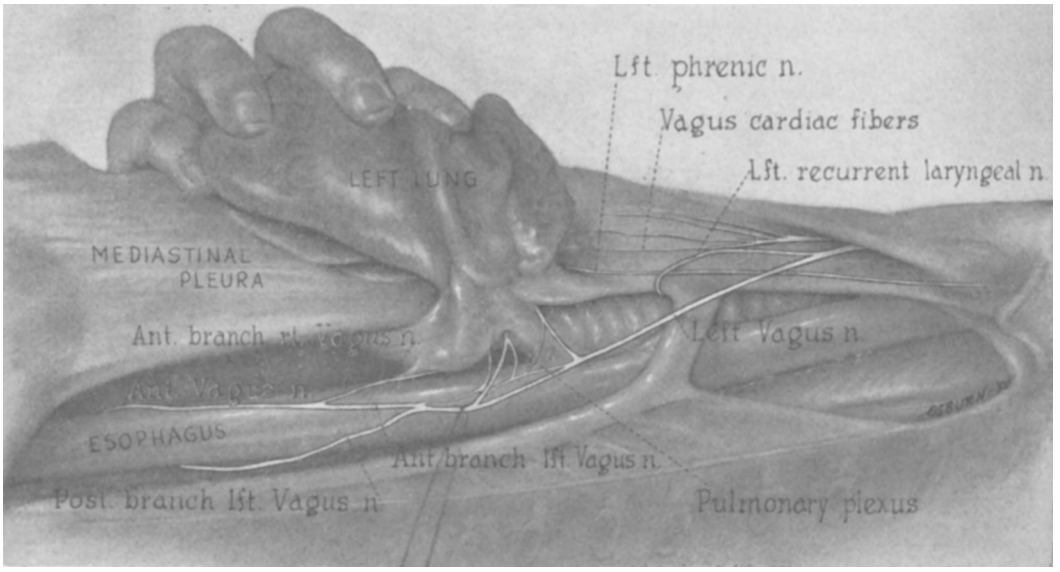

FIG. 4.
Relations of the thoracic vagi in the dog. The mediastinal pleura has not been represented fully in order to insure better visualization.

show the course and relations of the phrenic and vagus nerve on each side. Drawings were then made from the photographs (Fig. 3 and 4).

As the vagus nerves parted company with their respective carotid sheaths, each on entering the thorax gave off showers of nerve fibers, which ran to the base of the heart. Shortly thereafter, each vagus gave off a recurrent laryngeal nerve, the left as it crossed the aortic arch anteriorly, medial to the left subclavian artery, and the right as it crossed anterior to the brachio-cephalic artery. Then, running in the mediastinal pleura along the lateral walls of the trachea, the right passing under the azygos vein, the left having crossed the ascending aorta diagonally, both vagi passed the hili of the respective lungs pos-

teriorly. As they did so, numerous fibers were given off to each hilus, where the fibers united to form the pulmonary plexus, while the main trunk of the vagus continued caudad.

Below the level of the tracheal bifurcation, the nerves came to lie on the lateral walls of the esophagus, still invested in the mediastinal pleura. Immediately below this level, the right vagus divided into an anterior and a posterior branch. The left vagus divided into an anterior and a posterior branch a little farther caudad. As soon as the anterior branch of the right vagus was given off, it crossed the esophagus anteriorly and united with the corresponding branch of the left vagus in the anterolateral plane of the esophagus, approximately halfway between the level of the hilus of the lung and the diaphragm. The nerve thus formed, the *anterior vagus,* continued caudad with the esophagus and pierced the diaphragm a little to the left of the anterior plane of the esophagus. The nerve remained covered by, and invested with, mediastinal pleura during its entire progress through the thorax.

The posterior branch of the right vagus continued to run caudad and traversed the length of the esophagus on the right beginning anteriorily and gradually sloping posteriorly. A short distance before piercing the diaphragm, it was joined by the posterior branch of the left vagus to form the *posterior vagus,* which accompanied the esophagus through the diaphragm in the postero-lateral plane. The course of the left posterior vagus was a gradual sloping one *behind* the esophagus, passing almost the entire distance between hilus and diaphragm before coming to lie on the right postero-lateral wall of the esophagus where it joined the posterior branch of the right vagus.

Esophageal fibers were constantly given off by both vagus nerves in their course through the chest.

Comment. The course pursued by the right and left vagus nerves in the thorax as observed at the autopsy table agrees with that described by Jemerin and Hollander(3); however, in contrast to the report of McCrea(4), the right and left vagus nerves divided, below the level of the lung roots, usually into one anterior and one posterior branch. In only 2 dogs it was found that the left vagus divided into 3 branches, one going anterior and the other 2 coursing posterior. The supernumerary third branch was insignificant in comparison to the other 2; it also joined the right posterior vagus about 5 mm from the junction of the other left posterior vagus with the right. Plexus formation about the esophagus was observed in none.

Technic for Intrathoracic Vagotomy in dogs. Anesthesia. Intratracheal ether or a combination of morphine-pentobarbital sodium parenterally was used. In our hands, the latter was preferable. The fasting dog is given morphinae sulfas, 3 mg per kilo of body weight, intraperitoneally. This is followed in 30 minutes by 5 mg of pentobarbital sodium per kilo of body weight, intraperitoneally or intravenously. In about 5 minutes anesthesia is complete and a metal cannula, which is part of a positive pressure system, is inserted through the mouth into the trachea, and the jaws closed.

Surgical procedure. Placing the animal on its left side, the right thorax is entered aseptically in the seventh or eighth interspace through a 4 inch incision whose center lies in the mid-axillary line. Care should be taken to avoid the intercostal artery, vein and nerve, superiorly. A self-retaining retractor is inserted between the ribs and spread. At this point the anesthetist begins positive pressure.

Using a wet gauze sponge, the lower lobe of the right lung is grasped gently and pulled superior and anterior. This places the mediastinal pleura on the stretch for it is a continuation of the visceral pleura reflected off the lung. Thus, the mediastinum is exposed from the hilus of the lung to the diaphragm and the right vagus is easily identified running in the mediastinal pleura, posterior to the hilus of the right lung. This is in contrast to the right phrenic nerve, which passes anterior to the hilus, intimate with the pericardium. The mediastinal pleura is then incised with a long-handled knife just anterior to the right vagus about half-way between hilus and diaphragm. As a matter of fact, due to the long chest of the dog and the relatively high dome of the diaphragm, it is difficult to open the pleura at a lower level.

The right vagus is then hooked and a

hemostat applied. Tracing the vagus cephalad by pulling caudad on the hemostat, the division of the right vagus is found slightly inferior to the level of the hilus of the right lung. Consequently, the hemostat is on the posterior branch of the right vagus. By pulling cephalad on the posterior right vagus and following it along the lateral wall of the esophagus, the junction of this branch with the posterior branch of the left vagus is easily located slightly above the diaphragm. Here, the left vagus has just emerged from behind the esophagus. Maintaining cephalad traction on the hemostat, two more hemostats are applied distal to the juncture and approximately 1½ to 3½ cm of the posterior vagus, formed by this union, resected. The cut ends are ligated with cotton.

Keeping in the mediastinum and crossing the esophagus anteriorly, the left vagus is easily identified running parallel to this structure invested with mediastinal pleura. After hooking the nerve, it is dissected partially free and a hemostat applied. By creating caudad traction on the hemostat, the junction of the anterior branches of the vagus nerves is brought into view. This union is below the bifurcation of the left vagus. The hemostat, therefore, is on the *anterior vagus*. Another hemostat is applied and 1½ to 3½ cm or more of the nerve removed, the cut ends also being ligated.

Thus, both vagus nerves have been disrupted in the thorax and the operation is complete except for wound closure.

Summary. 1. The thoracic vagus as seen in 42 dogs that came to autopsy is described.

2. A method is presented for its disruption.

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Studies on Antigens of Human Red Cells. II. Serological Properties of Rh Factor in Elinin.* (17771)

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In a previous report(1) a lipoprotein fraction of red cells containing the Rh and A and B factors was described and given the name elinin. A new term was required since it was shown that the post-hemolytic residue of red cells (stroma) could be separated into two fractions by solubility differences and that elinin was biologically distinct from S protein (stromatin) in that the latter did not contain Rh or A and B activity. Since it has not been possible to obtain a further concentration of the Rh factor in elinin by chemical methods, purification of elinin by physical methods was necessary in order to characterize its chemical and biological properties and to prepare a uniform substrate for further attempts at fractionation. The details of the steps taken in the purification of elinin and the analysis of its chemical and physical properties are reported elsewhere(2,3). When uniform solutions of elinin‡ became available for animal and human injection we hoped to obtain the answer to two questions: (1)

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2. Moscowitz, M., Calvin, M., and Evans, R. S., in press.

3. Danlicker, W. S., Moskowitz, M., Zimm, B., Calvin, M., in press.

‡ We have retained the name elinin for the purified fraction of red cells containing the Rh and A and B factors.