Discussion. Since the original description of filamentous and sperm shaped virus particles[1-3] as contrasted with the spherical ones present in allantoic fluid and water we have been puzzled about the shape of the virus under physiological conditions. This is of practical interest in any attempt to study the virus in cells. Two things now seem to be fairly clear. First, the virus is probably spherical when present in solutions of physiological concentrations. This fully explains our previous failure to detect a change in shape by direct measurements of viscosity, light scattering and double refraction of flow.[5] However, it also seems clear that a change in shape will occur in hypertonic salt solutions, for elimination of the salt from the solution returns the virus to its previous shape if it has not been fixed by osmic acid.† To the following extent then the filamentous and sperm shaped virus particles are artifacts. They are formed by the increasing hypertonicity of the salt solution when it dries on the formvar screen. They are, however, real in that they probably exist in free solutions of somewhat hypertonic concentrations. They are at least roughly as active as the spherical forms, and do not lose activity any more rapidly than the spherical forms in water or physiological saline.

† Recent electron microscope observations by Elford *et al.*, *Brit. J. Exp. Path.*, 1948, **29**, 590, also indicate the presence of an osmotic membrane around the virus of Newcastle disease. We are in essential agreement with their results.

Summary. In 4 separate experiments it has been shown that the virus of Newcastle disease of chickens probably has a spherical shape when in water or .8% saline. If the concentration of saline is increased to two per cent or more the virus becomes filamentous. It may be fixed with osmic acid at this concentration and will then retain its shape when placed in water. It reverts to the spherical form when replaced in water without previous fixation. No loss of infectivity was detected during these changes in concentration of saline.

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17076. Effect of Acute Bradycardia on Pulmonary Vascular Pressures in Anesthetized Dogs.*

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Pulmonary edema, congestion and hemorrhage were reported in guinea pigs subjected to increased intracranial pressure; however, bilateral cervical vagotomy prior to elevation of intracranial tension resulted in a significantly lesser degree of pulmonary pathology.[1] Luisada and Sarnoff[2] employed massive, rapid venous infusion in dogs simultaneously with vagal stimulation and concluded "electrical stimulation of either the cardiac end of the cut vagi or the intact nerves favors pulmonary edema by causing extreme bradycardia".

The present authors[3] have reported bradycardia, decreased cardiac output, a significant rise in pulmonary venous pressure and pulmonary edema in dogs subjected to increased intracranial pressure. Intravenous administration of atropine after induction of the changes listed above as following maintained elevation of the intracranial pressure, reversed those changes, and significant pulmonary edema did not occur.

Methods. Mongrel dogs were anesthetized

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1 Campbell, G. S., and Visscher, M. B., *Am. J. Physiol.*, in press.

2 Luisada, A. A., and Sarnoff, S. J., *Am. Heart J.*, 1946, **31**, 282.

3 Campbell, G. S., Haddy, F. J., Adams, W. L., and Visscher, M. B., *Am. J. Physiol.*, in press.

TABLE I.
Integrated Mean Pressures in Pulmonary Artery and Vein in Relation to Heart Rate Changes.

	Wt. of dog, kg		Before vagal stimulation beats/min.	mm/Hg	During first min. of vagal stimulation beats/min.	mm/Hg	After vagal stimulation beats/min.	mm/Hg
1	15.7	Heart rate	216		72		240	
		Pulmonary venous pressure		4.0		14.8		4.5
		Heart rate	180		60		200	
		Pulmonary artery pressure		12.8		9.3		12.8
2	18.6	Heart rate	144		72		144	
		Pulmonary venous pressure		5.0		9.5		5.3
		Heart rate	144		48		130	
		Pulmonary artery pressure		16.0		14.0		17.3
3	24.2	Heart rate	180		72		180	
		Pulmonary venous pressure		6.3		11.3		6.3
		Heart rate	180		72		180	
		Pulmonary artery pressure		20.0		18.0		19.8
4	20.0	Heart rate	168		60		168	
		Pulmonary venous pressure		9.0		13.8		5.0
		Heart rate	168		60		180	
		Pulmonary artery pressure		16.3		15.3		17.5
Average		Heart rate	178		69		183	
		Pulmonary venous pressure		6.1		12.4		5.3
		Heart rate	168		60		173	
		Pulmonary artery pressure		16.3		14.2		16.9

with sodium pentobarbital, 30 mg/kg and No. 10 radio-opaque whistle-tipped ureteral catheters were put into the jugular vein and carotid artery. The catheters were passed into the pulmonary artery and pulmonary vein respectively with fluoroscopic aid. A small cannula was placed in the thoracic cavity and intrathoracic, pulmonary artery and pulmonary vein pressures were recorded with standard resistance wire pressure transmitters (Statham strain gauges).† A more detailed description of the technic employed was reported elsewhere.[4]

Femoral arterial pressure was measured with a mercury manometer, and jugular venous pressure was measured with a manometer filled with 5% sodium citrate. Heart rates were counted from the pulmonary artery pressure records. Integrated mean pulmonary vascular and intrathoracic pressures were measured with a compensating polar planimeter, and all pulmonary pressures reported herein are expressed in relation to intrathoracic pressure as zero. All dogs had an indwelling tracheal cannula.

A Harvard inductorium was used for faradic stimulation of the cardiac ends of the cut vagus nerves and acetylcholine and/or acetyl-beta-methylcholine were also employed in order to produce bradycardia.

Results and discussion. Faradic stimulation of the cardiac ends of the cut cervical vagi was employed to produce cardiac slowing to one-half or one-third of the control rate. There was a prompt elevation of mean pulmonary venous pressure, and a smaller fall in mean pulmonary artery pressure. Details of these observations are presented in Table I. The average values for the 4 dogs studied show a 6.3 mm Hg rise in integrated mean pulmonary venous pressure concomitant with the slowing of the heart rate from 178/minute to 69/minute. Simultaneously with the acute bradycardia in the same dogs the pulmonary artery pressure was lowered 2.1 mm Hg. It may be noted that in Dog No. 1 the integrated mean pressure recorded was higher in the pulmonary vein than in the pulmonary artery. Several factors com-

† Statham Laboratories, 9328 Santa Monica Blvd., Beverly Hills, Calif.

[4] Haddy, F. J., Campbell, G. S., Adams, W. L., and Visscher, M. B., *Am. J. Physiol.*, in press.

plicate this measurement, for example, the catheter aperture opens into the stream of blood in the vein and is oppositely situated in the artery. As a result the kinetic energy factor is added to lateral pressure in the first case and subtracted in the second. For this reason one cannot, without velocity measurements or their equivalent, give absolute lateral pressure values. It is possible, however, that with bradycardia the pulmonary vascular pressure gradient direction is actually reversed in diastole. A slow diastolic rise in pulmonary artery pressure seen only in this case would conform with this interpretation. The maximum systolic pulmonary arterial pressure is greatly increased in bradycardia.

In one case the cardiac output was measured by the direct Fick method before, during and immediately after vagal stimulation. The values obtained for the cardiac outputs were 3.2, 2.0 and 2.4 L. per min. in the 3 situations in the order named. The systemic venous pressures rose 2-6 cm H_2O during the vagal stimulation periods and the mean femoral arterial pressure fell slightly although the pulse pressure increased.

In two experiments with acetylcholine and one with acetyl-beta-methylcholine administered in such doses as to lower the heart rate to a half or less of the control value similar changes in pulmonary vascular pressures were recorded.

The observations recorded herein are entirely in harmony with predictions from classical hemodynamics. They are being reported primarily because they have a bearing on the mechanism of production of pulmonary congestion and edema, in states of bradycardia. In one respect the effects of acute vagal stimulation appear to differ from the results when comparable bradycardia occurs gradually after increasing the intracranial pressure. In the latter case the pulmonary artery pressure rises, in contrast to the fall reported herein for acute vagal bradycardia. It should be noted that when vagal stimulation was continued for 10 minutes, the bradycardia being maintained, the pulmonary artery pressure rose to values above the control level. The pulmonary venous pressure remains elevated. The mechanism of the delayed rise in pulmonary artery pressure has not been analyzed. It is obvious from the observations reported here that simple bradycardia can account for the elevation in pulmonary venous pressure seen when cardiac slowing results from elevations in intracranial pressure. Since in the latter situation the ensuing pulmonary edema is correlated with the pulmonary venous pressure[3] one can also link the genesis of the edema with bradycardia.

Summary. The bradycardia produced by vagal stimulation and by the administration of acetylcholine or acetyl-beta-methylcholine resulted in an elevation of mean pulmonary venous pressure and a small fall in mean pulmonary artery pressure. These observations are discussed in relation to the genesis of pulmonary edema in situations in which bradycardia occurs.

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17077. Production of Anemia in Swine Fed Purified Diets and Sulfasuxidine.*

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In 1946 it was reported from this laboratory[1] that a pig maintained on a diet in which purified casein (Borden's Labco "vitamin-free") was substituted for crude casein (Sheffield's New Process) and to which 2 per cent

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1 Cartwright, G. E., Wintrobe, M. M., and Humphreys, S., *J. Lab. and Clin. Med.*, 1946, **31**, 423.