

K-indigo tetrasulphonate was found to penetrate into the sap in a yellow form.

K-indigo disulphonate could not be found in the sap by means of the method used.

The electrode potential or  $E_h$  of the protoplasm was tentatively found to be between .21 and .48 subject to certain assumptions. The  $E_h$  of the sap was found to be between .12 and .15, subject to certain assumptions. By further calculations, the rH or the logarithm of the reciprocal of the hydrogen pressure of the sap was found to be between 16 and 18; that of the protoplasm was less exactly defined.

In this connection it is interesting to make a comparison with the work of Needham and Needham<sup>1</sup> who found the rH of the cell interior of *Amoeba proteus* to be between 17 and 19 (subject also to certain assumptions). It is quite striking that the rH value for the sap of *Valonia* and that for the cell-interior of *Amoeba proteus* should be so nearly alike since they are such widely separated forms and since the methods of experimentation were so different. It may be that this value, when much more accurate methods of experimentation are used, is the same for all forms of life, or that there is a slightly lower oxidation potential in animals than in plants as seen from Needham's work.

## 2927

### A method for the experimental production of lung abscess.

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(Introduced by Peyton Rous).

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The study of lung abscess in the laboratory has been handicapped by the difficulty of reproducing such a lesion in the experimental animal. It occurred to us that this might be due to the fact that almost all investigators started with the assumption that lung abscess was caused by the aspiration of infected material,

<sup>1</sup> Needham, J., and Needham, D. M., *Proc. Roy. Soc.*, B, xviii, 259.

and, therefore, devoted their energies towards the production of such lesions by the placement of infected materials in the trachea and bronchi. Recent studies in other types of postoperative lung complications would seem to indicate that emboli from the operative field were the dominant factor in the ensuing complication. We felt that lung abscess might well have a similar etiology.

#### *Method.*

The method consists in liberating into the venous blood stream infected emboli which ultimately lodge in the lung. The animal is anesthetized with ether, following the administration of morphia, 1/6 or 1/4 gr. The right jugular vein is exposed and isolated for about three centimeters. A transverse incision is made large enough to admit a glass cannula about 0.8 cm. in diameter. Bleeding is controlled by bull-dog clamps, or by tapes passed around the vein and weighted with clamps. An embolus of infected tissue,\* is then placed in one end of the glass cannula, which is introduced into the jugular vein. The other end is connected with a large syringe containing salt solution and the embolus is forced into the circulation by emptying the syringe. The opening in the vein is closed with silk.

In reviewing the results obtained so far, we find that in twelve out of seventeen attempts we were able to produce a definite lung abscess by the introduction of an infected embolus into the jugular vein. (Figs. I to IX.)

In fifteen instances the embolus lodged in the left lower lobe, and in only two instances in the right lower lobe. This is explained on the basis of the more direct and straight course pursued by the left pulmonary artery as compared to the right pulmonary artery in the dog, and by the larger and more direct channel that characterizes the artery to the left lower lobe as compared to the other branches of the left pulmonary artery.

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\* The embolus is prepared as follows: The femoral vein is isolated, its branches are ligated, and a segment 12 to 18 millimeters long is removed. One end of this segment is ligated with silk. The other end is held open by three silk sutures. Into the lumen of this small segment of vein, an emulsion of bacteria is introduced by a platinum loop, together with one or two small bits of lead, previously coated with paraffin so as to render them inert. A drop of blood is then added and the second end tied. The small bits of metal are added in order to study roentgenologically the final resting place of the infected embolus.

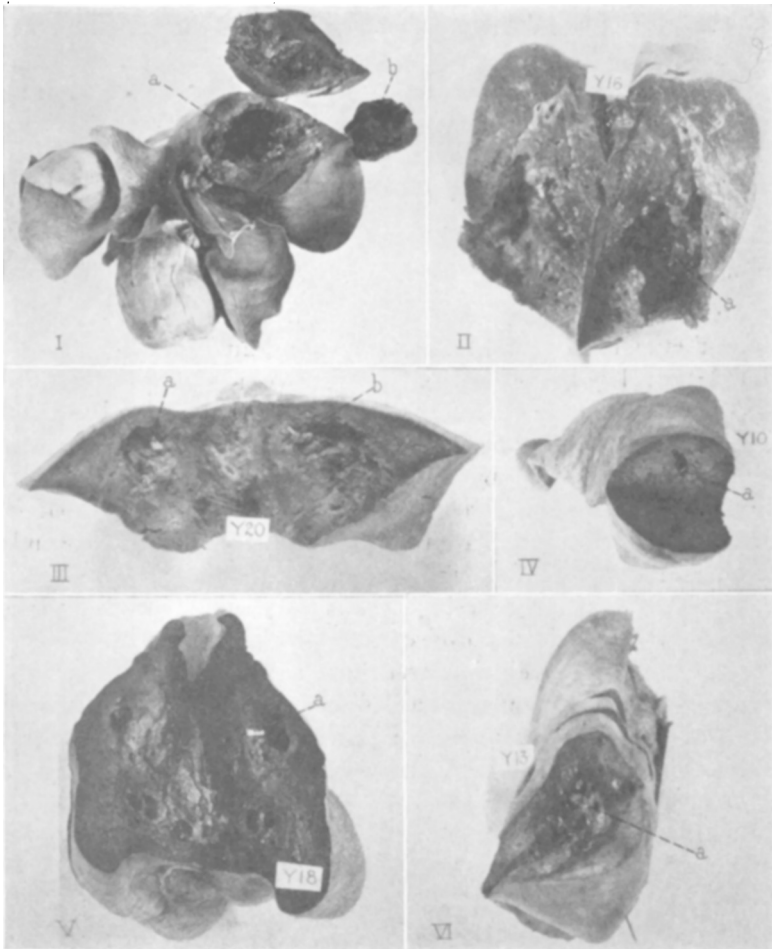


FIG. I. Lung removed from Dog Y 5, 5 days after introduction of infected tonsil tissue into left jugular vein.

a—abscess cavity.

b—blood clot removed from cavity.

FIG. II. Left lower lobe removed from Dog Y 16, 8 days after introduction of infected tonsil tissue into jugular vein.

a—large abscess which ruptured into pleural cavity.

FIG. III. Left lower lobe removed from Dog Y 20, 6 days after introduction of segment of vein impregnated with *staphylococcus aureus* and *B. coli* into jugular vein. The animal is still living.

a—lead filing in abscess cavity.

b—segment of vein in abscess cavity.

FIG. IV. Left lower lobe removed from Dog Y 10, 15 days after introduc-

tion into jugular vein of muscle tissue impregnated with *staphylococcus aureus*. The animal is still living.

a—lead filing in abscess cavity.

FIG. V. Left lower lobe removed from Dog Y 18, 10 days after introduction of segment of vessel impregnated with *staphylococcus aureus* and *B. coli*. The animal is still living.

a—lead filing in abscess cavity.

FIG. VI. Left lower lobe removed from Dog Y 13, 14 days after introduction of small cylinder of potato impregnated with *staphylococcus aureus* into jugular vein.

a—potato fragment in abscess cavity.

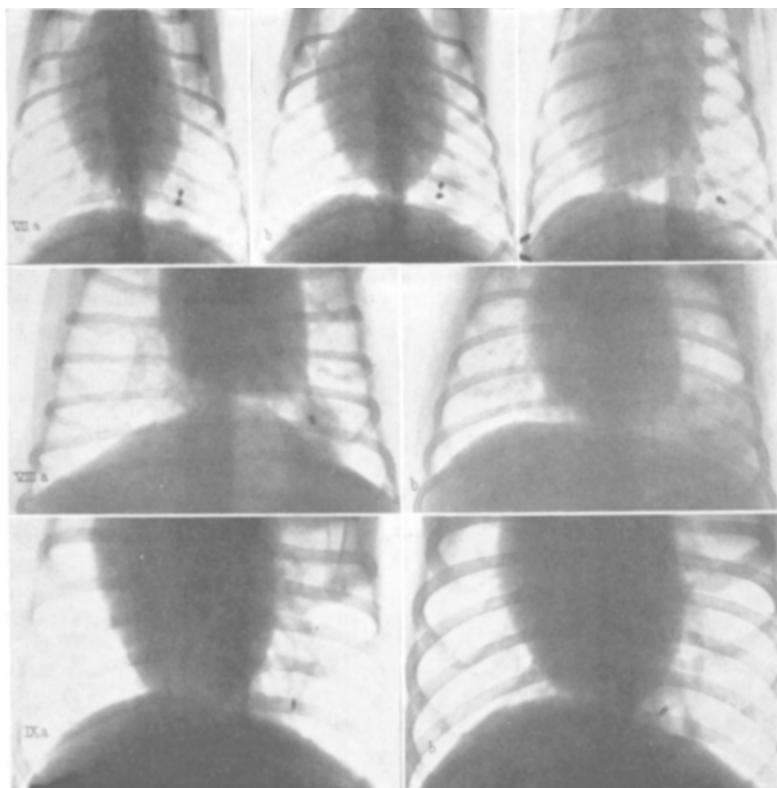


FIG. VII. Roentgenograms of Y 10 following introduction of infected embolus into jugular vein.

a—on the third day.

b—on the fifth day.

c—on the seventh day.

FIG. VIII. Roentgenograms of Y 20 following introduction of infected embolus into jugular vein.

a—on the second day.

b—on the sixth day; marked cavitation.

FIG. IX. Roentgenograms of Y 19 after introduction of infected embolus into the jugular vein.

a—on the second day.

b—on the ninth day.

In five instances an abscess failed to develop. At necropsy, two of these cases presented the signs of a healing infarct with scarring and pleural adhesions on the surface of the affected lobes. In three animals, the roentgenograms showed no evidence of abscess formation, and the dogs have remained well.

#### *Conclusions.*

Thus far our experiments have led us to believe that we can produce lung abscess with a fairly high degree of success and the method may perhaps furnish further experimental evidence in favor of the embolic theory of lung abscess.

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### **A continuous electrical method of recording the volume-flow of blood.**

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The method employed is based on the principle that the amount of heat, radiated by circulating blood led through a tube, varies

