THE FILTERING CAPACITY OF LYMPH NODES

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PLATES 29 AND 30

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Lymph nodes have two obvious functions, the production of certain cells and the arrest of foreign material brought to them by the lymph. The second of these functions, that is, the filtering capacity of the nodes, has been the subject of a large amount of indirect experiment and speculation. It would be unprofitable and entirely repetitive to describe this work in view of the excellent reviews of Hellman (1) and Oeller (2).

The nodes are held to provide two sorts of filtration, the first of simple mechanical type and the second biological—due particularly to the phagocytic activity of the reticulo-endothelial cells. Opinions as to the combined efficiency of these two types—normal nodes alone being under consideration—vary from assertions of complete effectiveness to very much the reverse.

As a result of a great deal of experience with the lymphatics in the hind leg of the dog, it became relatively simple for us to perfuse the popliteal and iliac lymph nodes under conditions of pressure and flow normal for the animal and with the blood circulation completely intact. Prior to a description of typical experiments it will be well to review the architecture of a lymph gland, such as the popliteal node of the dog, together with what is known of the normal flow of lymph through it.

Text-fig. 1 is a drawing of a popliteal node injected with a dilute solution of India ink. The injection mass has been delivered through a cannula in one of the large trunks along the saphena parva vein. The injection pressure was 20 mm. of mercury. This is less than the
pressure which can be developed in the same vessel when the muscles of the leg are stimulated electrically. The injection enters the node through a number of afferent trunks which pierce the capsule obliquely and open into the marginal or cortical sinus. This sinus is not a channel but is a large bowl-shaped lake, bounded upon the outside by the capsule of the node and on the inside by the lymphocytic parenchyma. The lake is traversed by fibrous trabeculae and blood vessels and, like all the sinuses, is crossed and recrossed by a fine mesh of reticulum most important for the filtering function of the node. From the cortical sinus irregular but numerous cleft-like channels, the intermediary sinuses, pass between the masses of lymphoid tissue.

TEXT-FIG. 1. Camera lucida drawing of a section of the popliteal lymph node of a dog injected through the afferent lymphatics with a dilute suspension of India ink. A, cortical sinus; B, intermediate sinus; C, afferent lymphatics in the capsule; D, lymphocytes. × 9.
toward the hilus of the gland, where they unite with the cortical sinus to form the efferent lymph vessel. It is a fortunate circumstance for our experiments that this vessel is usually single at the hilus, thus permitting complete collection of all the lymph passing through the node.

The architecture of the sinuses has a very direct relation to the filtering capacity of the node. Not only are they crossed and recrossed by the reticulum, but their walls are incomplete wherever lymphocytic growth is active (Drinker, Wislocki, and Field (3)). This means that at many points, particularly upon the inner surface of the cortical sinus, the lymph may run out into the lymphoid tissue.

Nordmann (4), as a result of study of sections of nodes, arrived at the conclusion that lymph traverses a node in three ways. Most of it reaches the efferent vessel without leaving the marginal sinus. A second fraction, much smaller, finds its way via the intermediary sinuses, and a third, very small part, drifts from the marginal sinus into the lymphoid tissue and finds its way back into the main stream either by rejoining the marginal sinus or by reaching an intermediary sinus. Maximow (5) adds another possibility, which we have not encountered; namely, an occasional endothelium-lined lymphatic which goes directly through the node. Such atypical vessels must be very infrequent and represent survivals of embryonic lymphatics which have remained free of lymphoid tissue.

In Text-fig. 1, the black injection mass fills the cortical sinus and is deposited upon the walls and reticulum of the intermediary sinuses. The masses of lymphoid tissue are but slightly penetrated by the ink, but the barrier to the entrance of the injection resides in the density of the lymphocytic accumulations rather than in an intact sinus wall.

Text-fig. 2 is a drawing of the iliac lymph node taken from the groin of the dog which provided the popliteal node seen in Text-fig. 1. The ink reaching the iliac node is that which passed through the popliteal node. It is clear that the marginal sinus is not entirely filled and that the ink has flowed into many intermediary sinuses. As a result of numerous injections it is our opinion that lymph entering the marginal sinus flows as readily through the intermediary sinuses as it does through the cortical sinus. The entire arrangement, from the point of view of mechanics, is excellent for filtration. Lymph flowing in
FILTERING CAPACITY OF LYMPH NODES

through a number of narrow channels, and under a very definite head of pressure, finds itself in a huge space with an enormous number of wide and irregular paths which lead to the hilus vessel. The flow is instantly slowed and the driving head of pressure practically lost. Not only are the sinuses in the node a perfect settling chamber, but the reticulum which they contain furnishes a multitude of baffles which again slow lymph flow and make it easy for the phagocytic cells composing the reticulum to perform their function.

EXPERIMENTS

It is difficult to perfuse lymph nodes in rabbits and cats. One can collect small amounts of fluid from afferent and efferent vessels, but a steady experiment run-

TEXT-FIG. 2. Camera lucida drawing of a section of the iliac lymph node taken from the dog which provided the popliteal node of Text-fig. 1. A, cortical sinus; B, intermediate sinus. × 13.
ning over some hours is a hard task. In dogs the diameter and toughness of the vessels which must be cannulated, and the large size of the popliteal node, make the problem quite simple.

Two varieties of preparation have been employed, in both instances using dogs anesthetized with nembutal. In the first, after a subcutaneous injection of 2 per cent trypan blue in the foot, an incision is made at the lower end of the popliteal space. This discloses the afferent lymphatics. A small quartz cannula is tied in a single branch about 5 cm. below the node. All other afferents at the same level are ligated. The cannula is then filled with dilute trypan blue in physiological saline, and this is driven into the gland under low pressure. The incision is now carried up the leg and the popliteal lymph node uncovered. The efferent lymphatic is deeply embedded in fat and lies at the upper end of the node. Unfortunately, it is usually upon the anterior surface of the node and correspondingly awkward to cannulate. When both cannuulas are in place the afferent line is filled with perfusate and connected to a small graduated reservoir containing the balance of the perfusing fluid. A constant head of pressure is provided by a small column of mercury adjusted by means of a levelling bulb.

In such a preparation as this, the lymph flow through the node is entirely isolated and one gets a volume of fluid from the efferent lymphatic which soon becomes equal to that delivered to the afferent vessel. The blood circulation need suffer no interference whatsoever.

In the second type of preparation the afferent lymphatic has been cannulated in exactly the same way. The thoracic and right lymphatic ducts were then isolated and the former cannulated. In order to make direct entrance of lymph into the circulation impossible, the precaution was taken to tie both subclavian veins central to the points of lymphatic entrance. In an animal so prepared, one has in the thoracic duct lymph a representation of what may reach the circulation after traversing the popliteal and iliac lymph nodes and the entire length of the thoracic duct.

As perfusion fluid, heparinized plasma from the dog employed in the experiment was usually the basic fluid. This was diluted with physiological salt solution until the protein content was approximately 1.0 per cent. To such artificial lymph, washed red corpuscles were added so as to give a count of approximately 25,000 per c.m.m. This is a reasonably normal lymph, containing red cells from the dog under experiment as the particles to be filtered out. In a slow, non-pulsatile perfusion it is necessary to equip the perfusion reservoir with a stirring device in order to prevent sedimentation of red cells. When hemolytic streptococci were used as particles, they were grown in a mixture of broth and 20 per cent dog serum, or in dog serum alone. In certain experiments the culture was employed as perfusate without dilution; this being done to gain a graphic expression of the sites of arrest of the organism in the node and also to see whether, in the presence of great numbers of cocci, the organisms could be found in blood capillaries within the perfused gland. When cultures were diluted with physiological saline, the final mixture contained approximately 1 per cent of dog serum protein.
Two strains of hemolytic streptococci were employed. One of these, known as Streptococcus 1, was isolated from a human case and was highly virulent for mice, but caused no reaction in normal dogs when injected into the blood stream, into the lymph stream, and subcutaneously. The second strain, Streptococcus 2, was isolated from edema fluid collected from the leg of a dog in which the lymphatics had been completely obliterated. This animal had had eight attacks of chills and fever similar clinically to those occurring in human beings with lymphedema and elephantiasis. Early in these attacks, which occurred spontaneously, a streptococcus was invariably present. This organism causes a brief period of fever when large amounts of culture are injected subcutaneously in normal dogs, and a severe febrile reaction when injected into the lymphedematous leg of a dog with lymphatic obstruction. The organism is non-virulent for mice. So far as filtration was concerned, no differences between the two organisms were noted, and the experiments cited are all concerned with Streptococcus 1.

Experiment 1. Dog, Weight 19.3 Kilos.—Perfusion of the popliteal node with red cells from the dog used in the experiment. These cells were suspended in the dog's own heparinized plasma diluted with physiological saline to contain 1.06 per cent protein. Red cell count in the perfusate 26,400 per c.mm. Perfusion pressures 16 to 20 mm. Hg. In 2 hours and 5 minutes, 9 cc. of perfusate ran in, and 7.6 cc. were collected from the cannula in the efferent lymphatic. The total effluent was collected as 13 separate specimens. Of this number, 9 contained no red cells. 3 contained 200 red cells per c.mm., and 1 contained 400 red cells per c.mm. Filtration has been fairly complete. If in such an experiment the node is massaged, even very gently, the effluent at once contains red cells in large numbers.

On microscopic section, red cells were found in both cortical and intermediate sinuses, but were most numerous in the latter. Many were phagocytized by reticulo-endothelial elements, but the greater number lay in closely packed masses scattered through the reticular meshwork of the intermediate sinuses.

Experiment 2. Dog, Weight 18.7 Kilos.—Perfusion of the popliteal node with an undiluted serum-broth culture of Streptococcus 1. Culture contained 600,000,000 colonies per cc. Perfusion pressure 34 mm. Hg. In 1 hour and 20 minutes, 5 cc. of the culture ran into the node and were collected from the efferent lymphatic. Cultures of the entire effluent showed 4,500,000 colonies per cc. Filtration was 99 per cent complete.

Fig. 1 is a camera lucida drawing of a section of this popliteal node. Part of the cortical sinus is seen just beneath the capsule in the right side of the illustration. The black material in this sinus, and in the Y-shaped intermediary sinus, consists of masses of streptococci both
Fig. 2 shows part of the marginal sinus just above a dense collection of lymphocytes into which the organisms have not penetrated. This last is not invariably the case. Regions were found where the lymphocytes were quite solidly packed, but here and there large mononuclear or, occasionally, polymorphonuclear cells containing cocci were seen. Fig. 2 is a higher magnification of part of the cortical sinus. When a gland is given such huge dosage as was the case in this experiment, blood cultures occasionally become positive, and this when the precaution has been taken to tie the thoracic and right lymphatic ducts and both subclavian veins. The explanation apparently resides in the migration into blood capillaries in the node of phagocytes containing streptococci which are still capable of growing. Fig. 3 shows a capillary in the loose tissue just outside the capsule of the perfused node of Experiment 2. In addition to red cells, it contains 9 white cells containing microorganisms. Schulze (6) has summarized the literature and produced experiments to the effect that the capillaries in lymph nodes possess walls which are not solid, so that there is a direct communication between the blood and lymph. If this were true, microorganisms might enter blood capillaries in nodes, provided some force could be found which would develop a current into the capillaries. In the spleen, such a force is supplied by the smooth muscle in the capsule and trabeculae. The pulsations of the organ drive fluid and cells back into the circulation, the latticed splenic capillaries being easy to enter. We have been unable to produce contraction of the popliteal lymph node in the dog, nor have we found smooth muscle in the capsule or trabeculae. If a node is perfused too vigorously, or if the outflow is obstructed, swelling is readily produced and on removal of the cause goes away slowly; not as would be the case if smooth muscle contracted, but as a gradual return expressing a poor degree of elasticity.

It is not easy to see just how a lymph node could retain structural integrity if it possessed open blood capillaries and no power of rhythmic contraction which might be counted upon to drive plasma and cells back into the blood vessels and clear the node of the excess transudate which must steadily accumulate. Furthermore, if the capillaries in the popliteal node are open, then lymph collected from afferent vessels ought to contain much less protein than that from the efferent side. This is not the case. Protein concentrations are identical.
Apparently the vascular system in the popliteal node is closed and ameboid activity is essential for entrance. This may not be the case with other nodes in the dog, and between different animals wide variations may exist. The subject is of real importance, since open capillaries in certain groups of nodes might account for high lymph protein, a finding often hard to explain on the basis of water absorption alone.

Experiment 3. Dog, Weight 21.2 Kilos.—Perfusion of the popliteal node with a diluted dog serum-broth culture of Streptococcus 1. Organism an 18 hour culture. Dog serum obtained from the animal used in the experiment. Perfusion pressures 20 to 30 mm. Hg. In 1 hour and 18 minutes, 7 cc. of perfusate ran into the node, and 6.1 cc. were collected from the efferent lymphatic. The results as regards filtration are expressed in Table I. No explanation can be given for the sterility of the last specimen of effluent. In this instance the blood remained sterile and no organisms were found in the thoracic duct lymph.

On microscopic section the node seems to have been slightly stretched and edematous. Organisms can be found only after long search and always attached to endothelial cells in the reticular framework of the cortical sinus.

Experiment 4. Dog, Weight 21 Kilos.—Perfusion of the popliteal node with a diluted culture of Streptococcus 1. Serum obtained from the animal used in the experiment. Perfusion pressures 14 to 24 mm. Hg. During 60 minutes, 10.2 cc. of perfusate ran into the gland and 9.6 were recovered. The results as regards filtration are given in Table II.

When removed, the node did not appear distended, but on microscopic examination the sinuses were possibly overwide. Organisms were found on reticular strands and in the endothelial cells of the reticulum.

Experiment 5. Dog, Weight 23.5 Kilos.—Perfusion of the popliteal and iliac lymph nodes with an undiluted serum culture of Streptococcus 1. Organism a 1½ hour culture in serum taken from the animal used in the experiment. At the finish of the perfusion the perfusate contained 250,000,000 colonies per cc. Perfusion pressures 20 to 40 mm. Hg.

The right lymphatic entrances into the subclavian vein were tied. The thoracic
duct was cannulated in the neck and all lymph excluded from veins on the left side. As a final precaution the subclavian veins were tied central to the observed lymphatic entrances. The afferent lymphatic of the left popliteal node was cannulated in the usual way. Efferent vessels of the node were untouched. This experiment utilized Preparation 2, and was designed to indicate the degree of filtration accomplished by two nodes, together with the possible settling effect which might occur in the long flow through the thoracic duct. The results are summarized in Table III. In this case few organisms reached the thoracic duct, and even if the duct had been allowed to empty into the subclavian vein it is doubtful whether positive blood cultures would have been obtained.

At the close of the experiment, 3 cc of 2 per cent trypan blue were sent in

### Table I

**Perfusion Flow and Figures for Filtration of Streptococci in Experiment 3**

<table>
<thead>
<tr>
<th>Time (min.)</th>
<th>Perfusion inflow (cc.)</th>
<th>Perfusion inflow per min.</th>
<th>Perfusion outflow (cc.)</th>
<th>Colonies per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-16</td>
<td>2.0</td>
<td>0.13</td>
<td>1.5</td>
<td>Sterile in 0.4 cc.</td>
</tr>
<tr>
<td>16-36</td>
<td>2.0</td>
<td>0.10</td>
<td>1.8</td>
<td>100 colonies per cc.</td>
</tr>
<tr>
<td>36-57</td>
<td>2.0</td>
<td>0.10</td>
<td>1.8</td>
<td>2500 colonies per cc.</td>
</tr>
<tr>
<td>57-78</td>
<td>1.0</td>
<td>0.05</td>
<td>1.0</td>
<td>Sterile in 0.4 cc.</td>
</tr>
</tbody>
</table>

Perfusate at start 5,000,000 colonies per cc.
Perfusate at finish 30,000,000 colonies per cc.
Thoracic duct lymph after 46 minutes perfusion of node, sterile in 0.4 cc.
Blood cultures taken after 4, 48, and 75 minutes of perfusion, all sterile.

### Table II

**Perfusion Flow and Figures for Filtration of Streptococci in Experiment 4**

<table>
<thead>
<tr>
<th>Time (min.)</th>
<th>Perfusion inflow (cc.)</th>
<th>Perfusion inflow per min.</th>
<th>Perfusion outflow (cc.)</th>
<th>Colonies per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>1.7</td>
<td>0.11</td>
<td>1.7</td>
<td>15,000</td>
</tr>
<tr>
<td>15-30</td>
<td>2.7</td>
<td>0.18</td>
<td>2.3</td>
<td>30,000</td>
</tr>
<tr>
<td>30-45</td>
<td>3.1</td>
<td>0.20</td>
<td>2.9</td>
<td>60,000</td>
</tr>
<tr>
<td>45-60</td>
<td>2.7</td>
<td>0.18</td>
<td>2.7</td>
<td>120,000</td>
</tr>
</tbody>
</table>

Perfusate at start contained 300,000 colonies per cc.
Perfusate at finish contained 500,000 colonies per cc.
Thoracic duct lymph after 27 and 64 minutes of perfusion, sterile.
Blood culture taken after 68 minutes of perfusion, sterile.
through the perfusion cannula. This blue appeared promptly in the thoracic duct lymph. Both the popliteal and iliac nodes were deeply and uniformly stained, and neither showed evidence of edema either grossly or microscopically.

On section of the popliteal node, occasional organisms were found free in the cortical sinus. Most of them were attached to cells, frequently to polymorphonuclear leucocytes which were numerous all through the node sinuses. The large reticular cells were seen in the dense groups of lymphocytes. The iliac node showed a large number of polymorphonuclear leucocytes in the sinuses, particularly at the periphery of the node, but on long search no cocci were found.

**TABLE III**

<table>
<thead>
<tr>
<th>Time</th>
<th>Perfusion inflow</th>
<th>Perfusion inflow per min.</th>
<th>Thoracic duct lymph Colonies per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>min.</td>
<td>cc.</td>
<td>cc.</td>
<td></td>
</tr>
<tr>
<td>11.40 a.m.</td>
<td>2.8</td>
<td>0.22</td>
<td>Control specimen sterile in 1.0 cc.</td>
</tr>
<tr>
<td>0–13</td>
<td>3.0</td>
<td>0.19</td>
<td>Sterile in 1.0 cc.</td>
</tr>
<tr>
<td>13–29</td>
<td>2.0</td>
<td>0.14</td>
<td>Sterile in 1.0 cc.</td>
</tr>
<tr>
<td>29–43</td>
<td>2.0</td>
<td>0.15</td>
<td>Sterile in 1.0 cc.</td>
</tr>
<tr>
<td>43–56</td>
<td>2.0</td>
<td>0.14</td>
<td>Sterile in 1 drop. Streptococci found in 1 cc.</td>
</tr>
<tr>
<td>56–71</td>
<td>2.0</td>
<td>0.13</td>
<td>Sterile in 1 drop. Streptococci found in 1 cc.</td>
</tr>
<tr>
<td>71–88</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Blood cultures, taken before perfusion and 25, 41, 73, and 89 minutes after perfusion, were sterile. At the finish of the perfusion the perfusate contained 250,000,000 colonies per cc.

In this instance, in which thoracic duct lymph is used to indicate filtration, it is clear that a high degree of efficiency has been obtained.

**Experiment 6. Dog, Weight 24.5 Kilos.**—Experiment in every way similar to Experiment 5, except that a higher perfusion pressure was used, 40 to 50 mm. Hg instead of 20 to 40 mm. Hg. The results are summarized in Table IV. The perfusion at the close of the experiment contained 300,000,000 colonies per cc.

In this case filtration has not been so successful, due in all probability to the increased pressure and uniformly higher rate of flow. On removal, the popliteal and iliac lymph nodes were not distended. The cortical sinus of the popliteal node contains many cocci and these are found through the intermediate sinuses all the way to the hilum of the gland. Many of the organisms are free. About an equal number are
attached to reticular strands or polymorphonuclear leucocytes. Cocci can be found in capillaries both free and in phagocytes. The iliac node shows many organisms, almost as heavy a load as in the popliteal gland, and in the same situations.

In this perfusion the first node was evidently quite inadequate, but the second in the line has been fairly successful in blocking the organisms and this in the face of a rapid flow of a perfusate heavily loaded with streptococci.

### TABLE IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Perfusion inflow</th>
<th>Perfusion inflow</th>
<th>Throracic duct lymph Colonies per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>min.</td>
<td>cc.</td>
<td>cc.</td>
<td>Control specimen sterile in 1.0 cc.</td>
</tr>
<tr>
<td>12.59 p.m.</td>
<td>3.3</td>
<td>0.22</td>
<td>Sterile in 1.0 cc.</td>
</tr>
<tr>
<td>0–15</td>
<td>2.9</td>
<td>0.19</td>
<td>60 colonies per cc.</td>
</tr>
<tr>
<td>15–30</td>
<td>3.1</td>
<td>0.20</td>
<td>1,000,000 colonies per cc.</td>
</tr>
<tr>
<td>30–45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A final thoracic duct lymph specimen, taken 15 minutes after ceasing perfusion, contained 7,000,000 colonies per cc. Blood cultures, taken 20, 41, 55, and 70 minutes after perfusion began, were sterile. A final culture at 82 minutes showed streptococci. At the finish of the perfusion the perfusate contained 300,000,000 colonies per cc.

### DISCUSSION

Several points are of importance in considering the actual significance of these experiments. It has been shown that the large afferent lymphatics in the leg of the dog will support pressures as high as 81.0 mm. Hg (Field, Drinker, and White (7)). Such pressures as this were obtained as a result of sterile inflammation of the foot. In an afferent lymphatic just below the popliteal gland, one of the vessels utilized in our perfusion experiments, pressures of 50 mm. Hg have been observed during repeated passive motion of the foot. It is thus clear that in normal animals moving about actively, lymph pressures equaling those in our perfusions may occur. Measurements of the flow of lymph from an afferent lymphatic below the popliteal node in walking and running dogs (White, Field, and Drinker (8) and Weech, Goettsch, and Reeves (9)) show that such rates of flow as have been used in our
perfusions are not abnormal. In a quiescent dog the flow of lymph from such vessels soon becomes negligible and the lymph pressure falls to zero. If one considers the degree to which lymph nodes might filter organisms under actual conditions of disease, it is apparent that they would be subjected to a much less severe task than that imposed by our experiments. Given a cellulitis of the foot, the dog is ordinarily quiet and a heavy flow of lymph would not occur until swelling became extreme. It is also certain that lymph nodes in actual disease would rarely be confronted with such a deluge of organisms as has been placed directly in the lymphatics in our experiments.

The perfusions cited in this paper are typical examples of thirty-five experiments. They indicate that lymph nodes, even under extreme conditions, possess a high degree of filtering efficiency. Efforts were made to determine how far this is mechanical and how far biological. Streptococcus 1, grown on serum-broth in an 18 hour culture, was not encapsulated. When grown in dog serum for 1½ hours, capsules were apparently present. In this second condition the cocci were less readily phagocytized by the dog's leucocytes, but perfusion of both types of organism showed no certain differences, though such an experiment as that summarized in Table IV does indicate a rather large escape of an encapsulated organism which was compelled to drift through two nodes.

There is a final point of general interest upon which these experiments throw possible light. It has long been a question as to whether lymph leaving a region of subcutaneous drainage can reach the bloodstream without passing through a lymph node. In such experiments as Nos. 5 and 6—and eight of these were made—the thoracic duct lymph never showed an immediate deluge of cocci such as might be expected if nodes were short-circuited by vessels passing around them. Apparently lymph from peripheral regions does not reach the blood until at least a single node has been passed. This may not be invariable, but certainly in our experience it was the rule.

Finally, our facilities for work have not permitted us to test the filtration of microfilariae. Judging from the results with red cells, where filtration is complete, such large elements as the filariae would have great difficulty in passage. It is our hope that this paper may cause workers in the tropics to try such an experiment.
In anesthetized dogs the popliteal lymph node alone, and the popliteal and iliac lymph nodes in series, have been perfused with solutions containing dog erythrocytes and streptococci. The perfusions have been carried out under conditions of lymph flow and pressure within the limits of those occurring in the actively moving dog, or after a severe degree of inflammatory swelling has developed. Figures for filtration are given, with protocols of typical experiments. They indicate that normal lymph nodes possess a high degree of filtering efficiency—an efficiency so great as to make it fairly certain that in a part kept at rest early in an infection, practically no microorganisms would escape the nodes in the line of drainage.

BIBLIOGRAPHY

EXPLANATION OF PLATES
PLATE 29

Fig. 1. Camera lucida drawing of a section of the popliteal lymph node perfused with a serum-broth culture of Streptococcus 1 in Experiment 2. A portion of the capsule of the node is seen on the right. Dark masses are streptococci caught in the sinuses of the node. Gram-Weigert stain. × 139.

PLATE 30

Fig. 2. Camera lucida drawing of a part of the cortical sinus in the popliteal node of Experiment 2. Gram-Weigert stain. × 683.

Fig. 3. Camera lucida drawing of a capillary from the node of Experiment 2. Note the phagocytes containing microorganisms. Gram-Weigert stain. × 1300.
FIG. 1

(Drinker et al.: Filtering capacity of lymph nodes)
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