

—removed at autopsy. From 1 patient the sputum was collected on the 24th day of illness, a fact that may account for the very small amount of virus present.

From our investigation it is obvious that the sputum is an excellent material in which to demonstrate by mouse inoculation the presence of psittacosis virus, while the blood is not. Bedson's work<sup>4</sup> indicates that the virus can be obtained from the blood of patients provided such blood is injected into parrots or parrakeets. Our endeavors, however, have been directed towards the development of a satisfactory diagnostic test in the mouse, a quite safe host with which to work. It appears that we have been successful, and for more than a year no parrots or parrakeets have been employed for diagnostic purposes in our laboratory.

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### Normal and Pathological Permeability of the Lymphatic Capillaries in Human Skin.

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It is possible to test the permeability of the lymphatics by means of the vital dyes which have been used to study the permeability of small blood vessels.<sup>1</sup> Observations on the normal and pathological permeability of the lymphatic capillaries in the mouse ear have been reported in previous papers.<sup>2, 3</sup> The present communication concerns itself with the functioning of the lymphatic capillaries in human skin under various conditions. Dyes of graded diffusibility have been used (pontamine blue, Chicago blue, patent blue V, Neptune blue, and phenol red) in the isotonic vehicles 0.9% sodium chloride solution, Tyrode's solution, and a mixture of Tyrode's solution 3 parts and 1 part homologous serum.

Practically any abrasion of the skin, no matter how slight, involves the passage of material into the skin lymphatics. Material thrust into it by scratch, puncture, injection, or superficial cut enters

<sup>4</sup> Bedson, S. P., Western, G. T., and Simpson, S. L., *Lancet*, 1930, **1**, 235, 345.

<sup>1</sup> Rous, P., and Smith, F., *J. Exp. Med.*, 1931, **53**, 219.

<sup>2</sup> McMaster, P. D., and Hudack, S., *PROC. SOC. EXP. BIOL. AND MED.*, 1931, **28**, 852.

<sup>3</sup> Hudack, S., and McMaster, P. D., *PROC. SOC. EXP. BIOL. AND MED.*, 1931, **28**, 853.

directly into these vessels. This happens to a much greater degree and much more rapidly than has been assumed. When a drop of isotonic dye solution is placed upon a scarification so mild that no blood is drawn, lymphatic capillaries carrying away the dye from the injured skin become visible in the neighborhood of the lesion almost immediately, under the dissecting microscope. Neutral paraffin oil flooded on the skin enhances visibility. Intradermal injections have been found to be predominantly intra-lymphatic. The results confirm and extend our observations upon the lymphatics of the mouse ear. The more diffusible the dye, the more ready is its secondary escape from the lymphatic channels; and a considerable proportion of the amount of a highly diffusible substance introduced directly into the lymphatics may pass into the interstitial tissue secondarily. Increasing the concentration of the dye enhances passage into the interstitial spaces, but adding serum to the vehicle retards it. Lymphatic capillaries in regions injured by heating, ultra-violet light, or by intradermal injection of bacterial toxins, are far more permeable than usual. In wheals caused by stroking or by histamine the lymphatics are so compromised that they fail to drain away dye stuffs in the usual manner. They are at times closed by pressure and in addition their walls appear to be abnormally permeable. Diffusible dyes devoid of specific affinities for tissue injected directly into acutely inflamed skin escape so rapidly from the lymphatics as to form a very deeply stained spot which contrasts strikingly with the broader and lighter-colored ill-defined patch that forms in a control area as result of the extension of dye within the normal lymphatic meshwork and its relatively slow secondary escape. If the inflammatory process has not progressed to purulence or necrosis dye soon begins to be carried away from the stained spot and decolorization is completed, while much color still remains in the control areas. It is plain that instead of a fixation of material in the inflamed region a more rapid turn-over of it than usual takes place.

It has been generally supposed, on the basis of experiments in anesthetized animals, that the lymph flow from a resting extremity is negligible. Our results show it to be remarkably rapid in the resting arm of normal man. Dye injected in minute amount into the skin of the forearm of a seated subject with the arm resting on a table appears in the large lymphatics of the axilla within 10 minutes. Local injections into normal skin are much less local than has been thought.