therewith. It is also possible to make legible projection material by simply typing the matter as one would a mimeograph stencil, on a blank piece of film. The ribbon can be left in, but it does not add greatly to the legibility and will smudge, as will a carbon under these conditions.

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SPECIAL ARTICLES

SELECTION WITH THE MAGNET AND CULTIVATION OF "RETICULO-ENDOTHELIAL" CELLS

THE supposition that certain highly phagocytic cells situated along the sinuses of the liver, spleen, bone-marrow, lymph-nodes and other organs have activities in common besides phagocytosis and constitute a physiological system, the "reticulo-endothelial system," has led to much discussion and experimentation. A host of functions, among them those of forming antibodies and bile pigment, are attributed to the cells in question. These attributions have been the easier because only oblique methods of test for them have been available.

Von Kupffer, the discoverer of the cells in the liver now classed as "reticulo-endothelial," observed that after the cells have taken up particulate material from the blood flowing by them, a greater or less proportion lose their hold on the capillaries and come away into the stream, new ones being provided by a proliferation and differentiation of the vascular endothelium. This happens irrespective of the character of the material phagocyted. We have taken advantage of the phenomenon to procure and cultivate the Kupffer cells.

A suspension of highly magnetic iron particles (the gamma ferric oxide of Baudisch and Welo[1]) in 7 per cent. gum acacia solution is injected into the circulation of a rabbit (or dog) on several successive days; and after two or three further days have elapsed—to give time for the particles ingested by blood leukocytes to be deposited—the animal is anesthetized and fluid is run directly through the liver, at first under low pressure to wash away the blood, then under high, with intermittent obstruction of the outlet tube and kneading of the liver to loosen and flush out the Kupffer cells. Warm Tyrode solution with 1/8 per cent. of gelatin for protective purposes[2] has proved as satisfactory a fluid as homologous serum. The Kupffer cells containing iron are separated from other elements by means of an electromagnet, past which the suspension is slowly run, "washed" with gelatin-Tyrode solution while still held by the magnet, and plated in a culture medium consisting of this fluid, plasma and serum.

When first obtained in serum or Tyrode's solution and studied in the warm box the Kupffer cells have the general character of clasmatocytes, but they exhibit in addition special traits which distinguish them from those phagocytic elements of the spleen and of old inflammatory exudates which are supposed like them to be components of the "reticulo-endothelial system." It is plain that this "system" consists of elements differing from one another to no inconsiderable extent.

Kupffer cells proliferate *in vitro* despite an initial content of iron particles that is often large; and they retain their specialized character. Since this is the case experiments with cultures should throw light on the functions of the cells. Such experiments are under way.

It is obvious that the magnet can be utilized for the selective separation of the phagocytic cells of organs other than the liver.

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[1] Provided through the generosity of Dr. Oskar Baudisch.

[2] Peyton Rous and J. R. Turner, *Jour. Exp. Med.*, 23: 219, 1916.

RELATION BETWEEN OXYGEN TENSION AND PROTEIN SYNTHESIS IN CERTAIN TISSUE EXTRACTS

IN previous work[1] we showed that a marked decrease in oxygen tension below atmospheric tension under otherwise constant conditions of pH, temperature, concentration of substrate, etc., increases the degree and the rate of proteolysis in certain normal and malignant tissues. These results suggested experiments designed to show whether oxygenation of digests of tissues containing suitable protein split products would or would not result in enzymatic protein synthesis. Concentrated extracts of the following tissues in phosphate buffer (pH approximately 7.0) were used: Voluntary muscle of albino rats and rabbits, Jensen rat sarcoma and Walker rat carcinoma 256. The extracts were subjected to a preliminary period of digestion in an atmosphere of purified nitrogen, toluene being added to prevent bacterial growth. The digests were then treated with a current of purified oxygen from 2 to 4 hours. The mixtures were finally allowed to digest again in an atmosphere of nitrogen. The protein content was deter-

[1] Carl Voegtlin and M. E. Maver, Public Health Reports, 47: 711, 1932; M. E. Maver, J. M. Johnson and Carl Voegtlin, Public Health Reports, in press.