chiefly the thoraco-epigastric, superficial epigastric and a superficial plexus of veins of the thorax and abdomen. (2) Deep veins, including the internal mammary, intercostals, azygos, hemiazygos, accessory hemiazygos, anterior and posterior mediastinal, pericardiaphrenic, phrenic, superior and inferior epigastric, lumbar, and deep anastomosing veins to the back muscles.

When the obstruction was above the junction with the azygos vein, the azygos system was a very important path of return flow to the heart but the abdominal collaterals were not well developed.

In the dog with obstruction of the superior vena cava including the azygos vein the flow of blood in the azygos system was evidently reversed and the superficial and deep abdominal collaterals carrying blood below to the femoral or iliac veins or to the inferior vena cava were much more prominent.

6459

A Study of Pannus Formation in the Cornea of Rabbits.*

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In the transmission of experimental trachoma to animals, perhaps the most significant and refractory difficulty is the complete lack of corneal involvement. Except in man where infection followed accidental or intentional transfer of trachomatous material. pannus formation has not accompanied folliculosis experimentally induced in a variety of animals. Since the appearance of cicatricial changes and pannus comprise the essential diagnostic differentiation between trachoma and folliculosis, the necessity is obvious for studying the conditions under which vascularization of the cornea is stimulated. While it is not yet clear that the data thus far obtained may be correlated eventually with pannus formation in trachoma, it is of interest that pannus may be evoked by various stimuli. From this point of view the experiments undertaken are here reported.

The experiments have been done on rabbits;† and because the results of a former study indicated that pannus may be a mani-

* This work was done under a grant from the Commonwealth Fund of New York.

† A total of 138 rabbits was used, about half for the experiments described

festation of bacterial hypersensitiveness, it was decided to study vascularization of the cornea as an allergic response. Rabbits have been sensitized to different bacteria; *Staph. aureus, Bact. granulosis,* Pneumococcus, diphtheroids and indifferent streptococci. Various methods for inducing hypersensitiveness of the cornea to bacteria were studied, but the most successful one was scarification of the cornea with one scratch reaching from below the sclero-corneal margin to the pupil, and then instilling into the conjunctival sac 2 drops of a young, actively growing culture. This treatment was repeated at weekly intervals. *S. aureus* proved to be the most effective sensitizing antigen, while *B. granulosis* was one of the least.

The experiments with *S. aureus* indicate that following the first 3 or 4 instillations, no visible reaction takes place. From the third to the fifth inoculations, the cornea undergoes a very definite reaction to the bacteria characterized by vascularization and increasing cloudiness which may be due to a keratitis. The vascularization begins in the form of delicate blood vessels springing from the injected conjunctival vessels. With repeated inoculations the corneal vessels form small fine loops which show anastomoses and later descend over the cornea not as loops but as a curtain of single vessels which terminate in crow-foot or brush-like processes. Eventually vessels appear from all directions, reaching centripetally from the entire circumference of the cornea. As long as the instillations are continued it is possible to keep the pannus and clouding present, so that in several animals by continuing inoculations for 22 weeks, pannus was maintained for months. The cornea undergoes clearing as the inoculations are discontinued and in a few weeks the eye regains grossly its normal appearance.

It has been determined also that vascularization of the cornea may be stimulated by injection of toxic materials, by mechanical injury, and by infection. Consequently the observation was occasionally made while studying the corneal changes to repeated infection that pannus may be stimulated by the first inoculation of bacteria. In these instances the pannus usually begins to appear within a week and does not require repeated treatments.

To determine whether the reactions described are due entirely or in part to repeated infection, hypersensitiveness, or some other factor, further experiments have been conducted in which the cornea has been sensitized to purified crystalline egg albumen. Rabbits

on bacterial sensitization, and 30 more in studying sensitization to albumen. Thirty-five were used in preliminary experiments leading to the ones reported at the present time.

were injected directly into the cornea or inoculated by combined scarification and instillation of egg albumen once a week. It has been possible to reproduce the corneal changes described above. The rabbits receiving intracorneal injections begin to show corneal changes within 3-4 injections, and eventually develop a very severe reactivity to egg albumen. In the rabbits receiving egg albumen by instillation and scarification, the reaction develops more slowly and never so severely. Rabbits receiving intracorneal injections of sterile physiological salt solution on the other hand show no increasing reactivity to successive injections.

While it is possible, therefore, to stimulate pannus formation in the cornea of rabbits under various conditions, it is clearly shown that vascularization of the cornea may accompany direct sensitization to live bacteria, or native proteins such as egg albumen.

6460

Effect of Acid Extract of Anterior Pituitary on Heart Rate, and Nervous Irritability of Guinea Pigs.*

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It has been observed that the injection of acid extract of cattle anterior pituitary produces in guinea pigs a condition comparable to that seen in Graves' disease in human beings. Loeb[1] has found a marked hypertrophy of the thyroid gland with diminution in the amount of colloid and a marked increase in the number of mitoses in the epithelial cells. Under the action of this substance the animals lose weight, and Siebert[2] has shown that there is an increase in their metabolic rate. Other effects corresponding to conditions found in Graves' disease have been established in subsequent investigations carried out in this laboratory. Inasmuch as tachycardia and nervous irritability are very prominent symptoms of Graves' disease in man it was of interest to study the effect of this extract of anterior pituitary on the heart rate and the reflex irritability of guinea pigs.

* These investigations were in part carried out with the aid of a grant for research in science made to Washington University by the Rockefeller Foundation.

1 Loeb, Leo, and Bassett, R. B., PROC. SOC. EXP. BIOL. AND MED., 1929, **26**, 860.

2 Siebert, W. J., and Smith, R., *Am. J. Physiol.*, 1930, **95**, 396.