

sufficed to cure the ophthalmia but a larger quantity appeared to be necessary to secure restoration of growth. Inasmuch as Cooper⁴ has reported the presence of vitamin A in orange peel, special precaution was taken in our work to avoid contamination of the juice with the latter.

Owing to the comparative richness of orange juice in carbohydrates, so that 10 c.c. represent a not inconsiderable intake of non-protein calories, it is important that the proportion of protein and essential salts in the rest of the ration be large enough to promote growth at the normal rate. The data now available from animal feeding experiments indicate the presence of vitamins A, B, and C in the orange and the possibility of conserving them, in part at least, undeteriorated by suitable processes of desiccation. With respect to the proportions of these different vitamins present our experiments indicate that volume for volume orange juice is as rich as is milk in vitamin B, but somewhat less rich in vitamin A. According to the data furnished by Givens and McClugage,⁵ orange juice is much richer than milk in vitamin C.

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Studies in experimental plethora in dogs and rabbits.

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The object of the present communication is to present the functional changes produced by repeated transfusions in the blood-making and blood-destroying apparatus, and in metabolism, and the structural changes in the viscera of dogs and rabbits. In an attempt to throw further light on the relation of the spleen to blood formation and blood destruction, we first studied the effect of splenectomy in artificial plethora, and tried to find evidence of increased enzyme action in the spleen removed at a time when blood was being destroyed in greatly increased quantities. Not only were these efforts barren of results, but it was

⁴ Cooper, *PROC. SOC. EXPER. BIOL. AND MED.*, 1921, xviii, 243.

⁵ Givens and McClugage, *Am. J. Dis. Child.*, 1919, xviii, 30.

also found that our knowledge of the changes caused by the artificial induction of plethora was in itself meager.

The effects of repeated transfusions of blood on the blood-destroying and forming apparatus of normal and splenectomized dogs and rabbits have been described. An anemia which developed in two splenectomized dogs during a plethora despite continued blood transfusions has also been studied.

The decrease or absence of reticulocytes from the blood stream during plethora and their increase during anemia is evidently due to depression and activation of bone marrow activity. The response of the bone marrow is not immediate upon the onset of anemia, but is developed after several days.

Blood volume studies have served to emphasize the constancy of plasma volume under extreme experimental conditions, and the adaptability of the circulatory system to large increases in total blood volume.

Blood destruction and elimination as measured by urobilin excretion is greatly increased during the induction of plethora, but still more so during "plethoric anemia."

Despite intravenous introductions of large quantities of nitrogen in the form of whole blood, the total nitrogen, urea and ammonia in the urine and feces is not raised appreciably for some time after the onset of plethora. The normal organism is apparently able to store large quantities of blood or its decomposition products. Upon the onset of a "plethoric anemia," there is an increase in urinary total nitrogen, urea and ammonia excretion, which is lowered during the course of the anemia. Albuminuria is also found at this time. Other nitrogenous constituents and phosphates show no striking changes.

Blood pigment, chiefly in the form of hemosiderin, is deposited in enormous quantities in the spleen, liver, lymphnodes and bone marrow. It occurs chiefly in phagocytes, though in late stages large extracellular masses are found. Increased pigment deposition can still be found several months after transfusions have been stopped.

Phagocytes containing erythrocytes are only occasionally found in the "acute" cases, but their occurrence may have been greatly masked by the coexistent congestion.

In splenectomized animals the tendency to "plethoric anemia" is much more apparent, although a direct connection between the two events has not been established.

In splenectomized animals pigment-bearing phagocytes are especially prominent in the liver, although lymphnodes and bone marrow apparently share in the extra work caused by the absence of the spleen. Lymphnodes with some of the characteristics of hemolymphnodes have been found in various localities in all animals that had been made plethoric.

In rabbits, blood pigment is deposited in the organs in large amounts, but the picture and the experiment has in our hands been constantly complicated by early fatal intravascular agglutination and thrombosis. In the rabbit, as in human hemochromatosis, the pigment is found in 2 forms: Hemosiderin granules, and smaller, dark spicules that do not react to the usual iron stains (probably hemofuscin). The latter pigment is also found seeded through the cells of the liver parenchyma.

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Changes in total peripheral resistance during experimental shock.

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The question as to whether the peripheral resistance is increased or decreased in experimental shock has been submitted to repeated investigations, but with contradictory results.¹ On the basis of changing contours of the aortic pressure curves found during the course of experimental shock, Wiggers¹ came to the conclusion that a reduced peripheral resistance obtained early in shock. Apparently contradictory results were however soon reported by Erlanger, Gasser and Gesell¹ who employed, in modified form, the procedure described by Bartlett²—a method which measures essentially the rate of saline inflow into the main artery of an organ or limb temporarily isolated from the rest of the arterial

¹ For recent review of literature cf. Wiggers, *Amer. J. Physiol.*, 1918, xlvii, 498; Erlanger, Gesell and Gasser, *Amer. J. Physiol.*, 1919, xlix, 103.

² Bartlett, *Jour. Exp. Med.*, 1912, xv, 415.