

exists an abnormal sulphur metabolism in pellagra which is reflected in the susceptibility of the skin to irradiation and is specifically related to the dermatitis of this disease. According to these authors the relatively high cystine content in wool and hair is of physiological importance in the protection of the organism against harmful effects of prolonged exposure to light. In this respect the changes and the falling out of hair of animals fed on buckwheat, as reported by Oehmke,¹ are of interest and perhaps of significance.

Conclusions. 1. There is no abnormal increase of the oxygen consumption during irradiation of plasma and tissues of various organs of guinea pigs made susceptible to light after prolonged feeding with buckwheat. 2. There is no conclusive evidence that the susceptibility to light of animals in buckwheat disease is due to a photodynamic substance.

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Cause of Increased Fragility of Erythrocytes in Congestive Heart Failure.

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Increased fragility of the red blood cells has been noted in certain patients with severe congestive heart failure.^{1, 2} With recovery from heart failure the minimum osmotic resistance of the red cells to hypotonic salt solutions returns to normal.^{2, 3} It was of interest to study the effect of anoxemia and stasis on blood in the capillaries and in the veins in producing these changes.

The studies were made on 10 convalescent ward subjects with no demonstrable cardiac, respiratory or hematologic disease. Using the hypotonic saline method of Daland and Worthley,⁴ the minimum osmotic resistance of the red blood cells obtained from the finger tips was observed. Complete circulatory arrest was produced by means of a standard blood pressure cuff applied to the right upper arm and rapidly inflated to a level 50 mm of mercury above the systolic pres-

¹ Franceson, M., *Minerva Med.*, 1936, **37**, 255.

² Waller, J. V., and Blumgart, H. L., to be published.

³ Butler, G. G., *Quart. J. Med.*, 1912-13, **6**, 145.

⁴ Daland, G. A., and Worthley, K., *J. Lab. and Clin. Med.*, 1935, **20**, 1122.

sure; this pressure was maintained for 10 minutes. Control observations were made on blood drawn from the finger tips of the left hand in each instance. Each finger tip, after lancing, was immersed in physiological saline containing a few drops of potassium and ammonium oxalate mixture as anticoagulant. In experiments 1, 2, and 3 all of the solutions were first boiled and cooled and layered with mineral oil and the entire procedure was thus carried out anaerobically. In all the remaining experiments, on the other hand, no attempt to prevent gaseous exchange with the atmosphere was made.

Various technics were employed in an endeavor to investigate the fragility of venous blood after stasis. In experiments 1, 2, and 3 ten cc of blood from a cubital vein was removed anaerobically before the release of the tourniquet. In 2 additional subjects (9 and 10), after 15 minutes of complete circulatory arrest, blood was withdrawn from a cubital vein in successive 15 cc samples as the forearm was wrapped, progressing from hand to elbow, in an Esmarch bandage. In this fashion from 60 to 90 cc of blood was withdrawn. The fragility of a sample from each syringe was observed and compared with that of venous blood taken from the other arm without stasis and with the fragility of finger-tip bloods taken before and after stasis.

Results. The decrease of the resistance to lysis in hypotonic saline of the red blood cells obtained from the finger tips was noted in 7 of 10 instances (Table I). Bloods 4 to 10 were thoroughly mixed with air while bloods 1, 2, and 3 were handled anaerobically.

In experiments 1, 2, and 3 the initial 10 cc of venous blood, even

TABLE I.
Beginning Fragility of Erythrocytes Obtained from Blood of Normal Finger or Arm Compared to That Obtained from Arm in which Stasis Had Been Produced.

Subject Number	Blood from finger tips		Blood from cubital vein	
	Without Stasis	With Stasis	Without Stasis	With Stasis
1	.44% NaCl	.48	.44	.44
2	.44	.50	.44	.44
3	.44	.48	.44	.44
4	.44	.48		
5	.48	.50		
6	.46	.46		
7	.44	.46		
8	.48	.48		
9	.44	.48	.44	.441*, .462, .485, .466
10	.46	.46	.48	.481, .522, .523, .505

* Small numbers refer to the sequence of withdrawal of the samples.

though handled anaerobically failed to show any change in fragility. Successive samples of venous blood from subjects 9 and 10, however, show a definite alteration of fragility (Table I).

The association of increased fragility of the red blood cells with the more severe degrees of cyanosis in congestive heart failure suggests that anoxia may account for the alteration of the fragility.

Previous workers^{5, 6} found that venous blood was more fragile than either arterial or capillary blood. The fragility of these bloods could be reduced to that of the arterial blood by bubbling oxygen through the sample of whole blood before clotting occurred. They also demonstrated the marked increase in fragility which occurs when carbon dioxide is bubbled through whole blood. This could also be reversed by subsequently bubbling oxygen through the blood. In the present study each sample of blood was dark and "cyanotic" on withdrawal from finger or vein. After the saline-cell suspension had been exposed to air by repeated inversion in tubes half filled with air, the red cells all took on the bright red color of oxyhemoglobin. Since definite alterations of the fragility of the red cells were present after equilibration with room air (subjects 4, 5, 7, 9, and 10) it is apparent that neither low oxygen tension nor a high tension of carbon dioxide was responsible for these changes.

The finding of increased fragility, after stasis, of blood obtained by capillary puncture or by venipuncture after expressing the capillary blood into the veins, in contrast to the absence of such a finding in blood which had merely been stagnant in the veins, suggests that the increased fragility results from certain effects of tissue metabolism under the conditions of the experiments.

Von Stejksal⁷ observed minimal increase of fragility in 2 of 5 patients after the production of stasis in one arm previously rendered "anemic" by elevation. He thought that the change in osmotic resistance of the red blood cells might be due to the action of a lysin present primarily in serum from anemic blood. Since the subjects of the present investigation were not anemic, von Stejksal's hypothesis is not tenable.

Conclusions. Increase in fragility of the red blood cells to hypotonic saline occurs in capillary blood in the presence of circulatory arrest. This is similar in degree and direction to that observed in congestive heart failure. These alterations may also be observed in certain samples obtained from a vein which contains an appreciable amount of capillary blood.

⁵ Dacie, J. F., and Vaughan, J. M., *J. Path. and Bact.*, 1938, **46**, 341.

⁶ Creed, E. F., *J. Path. and Bact.*, 1938, **46**, 331.

⁷ v. Stejksal, K. R., *Wien Klin. Wochenschr.*, 1909, **1**, 661.