was an increase in hemoglobin percentage and hematocrit reading. The average hemoglobin percentage before freezing was 96 and after freezing was 134. The average hematocrit reading before freezing was 47 and after freezing 66. The figures obtained in experiment 10 are higher than in any readings obtained in shock due to burns, except by Underhill in human beings. Control experiments showed no marked blood concentration and no fluid shift.[3]

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Shock Due to Freezing: II. Composition of Edema Fluid.*

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The composition of the fluid that escapes into the subcutaneous tissues after burns has been determined by Beard and Blalock.[1] These authors found that in general the chloride content of the fluid was higher than that in blood plasma, the concentration of sugar and non-protein nitrogen was approximately the same in the 2 media and the protein content of the subcutaneous fluid was about 20% lower than that of the blood plasma. Underhill and Fiske[2] made similar comparisons between the tissue fluid after burns and the blood serum. Their results agree in general with those of Beard and Blalock, except that they found the non-protein nitrogen content considerably higher in the edema fluid than in the blood serum.

The results of these authors indicate that the fluid that escapes into the subcutaneous tissues after burns very closely resembles blood plasma. The escape of a plasma-like fluid undoubtedly produces more serious consequences than the escape of a simpler solution. Hence, it was considered of importance to determine whether the fluid that escapes into the subcutaneous tissues in large amounts after freezing is of a plasma-like nature similar to that following burns. Nine completely anesthetized dogs in which shock was produced by freezing portions of the body with solid carbon dioxide were dissected after death and large amounts of edematous subcu-

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1 Beard, J. W., and Blalock, A., *Arch. Surg.*, 1931, **22**, 617.

2 Underhill, F. P., and Fiske, M. E., *Am. J. Physiol.*, 1930, **95**, 330.

taneous tissue found. By making multiple incisions in this tissue, sufficient fluid drained out for analysis. This fluid was only slightly tinged with blood, but clotted if no anticoagulant was added. A similar amount of anticoagulant was added to the edema fluid and to a sample of blood obtained from the carotid artery. Analyses were made of the fluid and of the blood plasma. The sugar was determined by the Folin '29 modification method on a sulfate-tungstate filtrate; the sodium chloride by the Eisenman open-Carius method; the protein by the Koch-McMeekin micro-Kjeldahl method; and the non-protein nitrogen by the same method on a Folin-Wu filtrate.

TABLE I.

A comparison of the concentration of certain substances in blood plasma and in the fluid that escapes into the subcutaneous tissues after freezing. The value for the sugar in the fluid in experiment 7 was too low to read.

Exp.	Sugar Mg. per 100 cc.		NaCl Mg. per 100 cc.		Non-protein Nitrogen Mg. per 100 cc.		Protein Gm. per 100 cc.	
	Plasma	Fluid	Plasma	Fluid	Plasma	Fluid	Plasma	Fluid
1	—	95.2	—	711.4	—	38.5	—	3.9
2	132.5	101.0	—	665.7	40.0	35.3	4.4	2.9
3	—	81.0	—	758.2	—	36.8	—	3.2
4	44.1	98.0	673.9	688.0	56.8	50.8	3.3	3.3
5	90.1	13.4	654.0	665.7	95.4	76.3	3.7	3.8
6	84.0	18.9	700.8	703.2	27.0	33.3	4.8	3.6
7	94.2	—	709.0	703.2	45.5	60.6	5.1	3.4
8	177.8	111.1	663.4	690.3	60.3	44.2	3.4	4.7
9	—	82.1	655.2	686.8	—	73.2	4.6	3.7
Aver.	103.8	66.7	676.1	696.9	54.2	49.9	4.2	3.6

The results of these analyses are shown in Table I. The sugar concentration is in general lower in the fluid than in the blood plasma. The extremely low values in several instances are of interest. The chloride concentration is approximately the same in the blood plasma and tissue fluid. The non-protein nitrogen and protein are somewhat higher in the plasma than in the tissue fluid.

Conclusion. The composition of the edema fluid that escapes into the subcutaneous tissues after freezing is quite similar to blood plasma. This indicates that the loss of large amounts of such plasma-like fluid from the blood stream might account, in part at least, for the shock resultant to the freezing.