Nineteen specimens of serum, representing 4 groups of Eskimos, were titrated for diphtheria antitoxin content, using the method of Flood.[3] The results, in units per cubic centimeter, are shown in Table II.

TABLE II.

Group	No. tested	No. showing antitoxin			
		None	1/45	1/22	>1/22
Pond Inlet	8	5		1	2
Dundas Harbor	2			1	1
Robertson Bay	6	3	1	1	1
Bache	3	2	1		
Total	19	10	2	3	4

More than half of the sera examined possessed no diphtheria antitoxin.

Because of these data and the fact that the respiratory flora in general was found[4] to be very similar to that of groups living elsewhere, we are inclined to believe that the mechanism of the production of immunity to diphtheria among Central and Polar Eskimos is much the same as it is among persons living in other latitudes.

Such a conclusion is strengthened by Bay-Smith's report[5] of outbreaks of clinical diphtheria among Greenland Eskimos, as well as the results of his 684 Schick tests showing 59% positive reactions. This investigator, although admitting that clinical diphtheria has been known to exist at least in certain groups of Eskimos, believes in a "spontaneous" origin of diphtheria antitoxin in the Schick negatives of the 684 Kap-Farvel and Julianehaab Eskimos. An outbreak described as clinical diphtheria in Central Eskimos has also been reported by Boas.[6]

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The Blood Sugar of Normal Fasting Persons.

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It has long been known that blood contains non-sugar substances that, in alkaline solution, reduce copper and other metals used in

[3] Flood, *Am. J. Dis. Child.*, 1930, **39**, 107.

[4] Being reported elsewhere.

[5] Bay-Smith, *Klin. Woch.*, 1929, **8**, 974.

[6] Boas, The Central Eskimo, *Sixth Annual Rep. Bur. of Ethnology*, 1884-1885.

sugar determinations. These reducing non-sugars are non-fermentable and account for the "residual reduction" of blood after yeast fermentation.[1] The blood sugar values recorded generally in the literature all represent the sum of the sugar and the non-sugar reducing substances. Somogyi[2] devised a technique of fermentation of blood with washed yeast for the accurate determination of residual reduction, thus making it possible to determine the true sugar by deducting the residual reduction from the total reduction value. Benedict[3] and Folin[4] also devised useful methods for the determination of true sugar. Somogyi[5] perfected a very simple method of precipitation with zinc salts whereby together with the blood proteins the reducing non-sugars also are precipitated and thus filtrates are obtained that contain no appreciable amount of reducing substances other than sugar. Using such zinc filtrates, true sugar values are obtained in a single determination by any of the titrimetric or colorimetric methods in general use. Somogyi[6] has obtained virtually identical results in zinc filtrates by the Schaffer-Hartman-Somogyi, the Folin-Wu, the modified Folin-Wu, and the Benedict procedures. Filtrates prepared by the older methods of deproteinization, on the other hand, yield sugar values that are too high and in addition variable according to the method employed, due to the differences in reducing power of the non-sugars with various reagents. This situation gave rise to much confusion and made impossible the correlation of results from different investigators. The possibility of the determination of true sugar makes it imperative that the confusing and misleading variety of "apparent" blood sugar values be discarded and true sugar values determined in their stead.

As a step to this end I have determined the fasting true sugar in the blood of 100 healthy normal adults, 50 men and 50 women. The blood samples were taken before breakfast, at least 8 hours after the last meal. Somogyi's microtechnique for zinc precipitation combined with the Shaffer-Hartmann method[7] was employed throughout this work. Blood was obtained by puncture of the finger tip and collected either directly into specially calibrated capillary pipettes or more conveniently, 5 to 6 drops were allowed to fall into a small beaker containing a minute amount of finely powdered

[1] Otto, J. J., *Arch. d. Ges. Physiol.*, 1885, **35**, 467.
[2] Somogyi, M., *J. Biol. Chem.*, 1927, **75**, 33.
[3] Benedict, R., *J. Biol. Chem.*, 1928, **76**, 457.
[4] Folin, O., and Malmros, H., *J. Biol. Chem.*, 1929, **83**, 121.
[5] Somogyi, M., PROC. SOC. EXP. BIOL. AND MED., 1929, **26**, 353.
[6] Somogyi, M., *J. Biol. Chem.*, 1929, **83**, 157.
[7] Somogyi, M., *J. Biol. Chem.*, 1930, **86**, 655.

potassium oxalate. In this work each result represents the average of 3 parallel determinations. In order to obtain a sufficient amount of blood, the hand was previously warmed in a basin of warm water.

The question may be raised whether capillary blood may be substituted for venous blood in sugar determinations. Our results corroborate Foster's[8] findings that in the fasting state the sugar content of capillary and venous blood is virtually the same. The degree of accuracy of the microtechnique was examined in the following experiment: In 17 cases sufficient blood was obtained from the finger to make parallel determinations by the micro and macro methods. In the latter the usual 1:10 dilution was employed. The results show that the values obtained by the 2 methods differ only by amounts that are within the limits of experimental error permissible for micro methods. All determinations were carried out at least in duplicate, usually in triplicate, with good agreement except in 2 cases. Comparing the results obtained by the macro and micro methods it is observed that the differences range between —4 and +8 mg. per 100 cc. of blood. The average of the discrepancies is 2.6 mg., the micro method yielding slightly lower results.

TABLE I.
Showing sugar content of successive blood samples taken from the same puncture.

Case No.	Mg. of sugar per 100 cc. of blood.				
	In specimens number			Greatest difference	Difference between first and last specimens
	I	II	III		
32	65	76	72	11	7
33	74	76	78	4	4
34	80	87	82	7	2
38	83	87	78	9	—5
42	72	80	79	8	7
43	76	87	84	11	8
44	85	73	72	13	—13
45	83	82	80	3	—3
48	87	84	86	3	—1
49	95	95	95	0	0
50	76	72	72	4	—4
51	79	83	88	9	9
52	76	84	84	8	8
53	85	90	92	5	7
57	88	76	73	15	—15
59	90	95	91	5	1
60	82	82	81	1	—1
62	87	90	84	6	—3
63	81	74	74	7	—7
64	72	80	87	15	15
Average				8.5	0.9

[8] Foster, G. L., *J. Biol. Chem.*, 1923, **55**, 291.

For most purposes the sugar values obtained by the micro technique are sufficiently accurate.

Changes in the composition of the blood due to admixture of tissue juices, consequent to repeated squeezing of the finger, have been assumed to affect the sugar content of finger blood. To obtain evidence on this point, successive blood samples were collected from the same puncture and the sugar determined separately in the several samples. Table I shows the results of 20 such experiments. These figures prove that any differences in the sugar content of these successive samples are within the limit of experimental error and not due to the admixture of tissue juices. It is found that the average difference between the first and last sample is only 0.9 mg. %.

Based on the foregoing findings it is fair to assume that the figures given in Table II represent actual fasting true blood sugar

TABLE II.
Showing the fasting true blood sugar of fifty male and fifty female normal adults.

Blood sugar, mg. per 100 cc. blood	Number of cases
Above 95 mg. %	0
90-95 "	9
85-89 "	19
80-84 "	35
75-79 "	28
70-74 "	9
Below 70 "	0
Total number of cases	100
Maximum blood sugar	95 mg. %
Minimum " "	70 "
Average " "	81.6 "

values of the persons analyzed. (The only selectivity employed in obtaining these persons was to reject any women in the catamenia.) The lowest blood sugar obtained was 70, the highest 95, the average of all cases was 81.6 mg. per 100 cc. of blood.* It is noteworthy that in the majority (63%) of the cases, the sugar values are within the rather narrow limits of 75 to 85 mg. %, and only 9 cases show more than 90 and 9 cases less than 75 mg. % of true blood sugar.

* Since this paper was prepared for publication, the communication of G. W. Holt and E. M. Greisheimer entitled "'True' glucose tolerance in forty-two normal individuals" appeared (PROC. SOC. EXP. BIOL. AND MED., 1931, **28**, 547). These authors found the true fasting sugar in 42 normal persons to be 83 mg. %, a figure in close agreement with the average of 81.6 mg. % reported in this paper. These results extend the statistical value of the analyses here given.

Summary. 1. The fasting blood sugar of 50 men and 50 women was found to be between 70 and 95 mg. per 100 cc. of blood, with an average of 81.6 mg. %. 2. Capillary blood may properly be substituted for venous blood in determining the sugar of fasting individuals. Admixture of other tissue fluids does not modify the sugar content of finger blood.