0.85% saline. Since the addition of either 5 or 10% glucose causes the same degree of inhibition, the amount of added glucose apparently is not an important factor.

Conclusions. Tyrothricin is markedly hemolytic for human and rabbit's erythrocytes. The hemolytic activity seems to reside primarily in the tyrocidine fraction, although gramicidin also exhibits a definite hemolytic effect. The addition of glucose to saline solution causes only slight inhibition of the hemolytic action.

13274 P

Peripheral Vascular Responses to General Anoxia.*

DAVID I. ABRAMSON, HARRY LANDT AND JULIEN E. BENJAMIN.
From the May Institute for Medical Research, The Jewish Hospital, Cincinnati, Ohio.

In view of the current interest in the problem of general anoxia in man, it was considered important to study the local changes in blood flow in the extremities consequent to the inhalation of an oxygen-poor gas mixture.

The investigation was performed upon 9 normal, adult subjects, using the venous occlusion plethysmograph method. Blood flow determinations, expressed in cc per minute per 100 cc limb volume, were made upon the hand, leg, and forearm, according to the technic previously described.[1] Ten to 15 control readings were first obtained with an anesthesia mask firmly fitted to the face, but with the subject breathing air from the room. Then a gas mixture of approximately 10% oxygen and 90% nitrogen was allowed to enter the mask at atmospheric pressure for periods of 10 to 20 minutes; the exhaled air being automatically discharged into the room through an outlet tube and flutter valve. Blood flow determinations were made every 2 minutes during this interval. At the completion of the period of relative anoxia, another set of control readings was obtained with the mask still in place, but with the subject again breathing room air. The pulse rate, blood pressure, and respiration were recorded simultaneously with the blood flow readings.

The hand was examined in 4 subjects and in each instance there

* Aided by the Samuel and Regina Kuhn Fund.

1 Abramson, D. I., Zazeela, H., and Marrus, J., *Am. Heart J.*, 1939, **17**, 194, 206; Ferris, E. B., Jr., and Abramson, D. I., *Am. Heart J.*, 1940, **19**, 233.

was an almost immediate decrease in blood flow coincident with the onset of the period of anoxia, and a return to, or even beyond, the control level within a few minutes after atmospheric air was inspired. In 2 of these instances, however, a definite diminution in hand blood flow had been observed with the application of the mask alone and before the oxygen-poor mixture was breathed; the vasoconstrictor response being further accentuated by the latter procedure.

The leg was examined in 9 subjects and in most instances no significant changes in circulation were noted during the first 5 minutes of anoxia. In the next 10 or 15 minutes, the rate of blood flow began to rise, to attain an average maximal increase of 30% above the control readings. This augmented flow was maintained during the remainder of the period, but quickly returned to the previous level with the readmission of room air into the anesthesia mask (Fig. 1). In the 6 instances in which the forearm was examined, the response was similar to that observed in the leg.

The pulse rate began to rise almost immediately after the onset of the period of anoxia (Fig. 1), to attain an average maximum increase of 23 beats per minute. As soon as this period was terminated, the pulse rate quickly dropped, in some instances tempo-

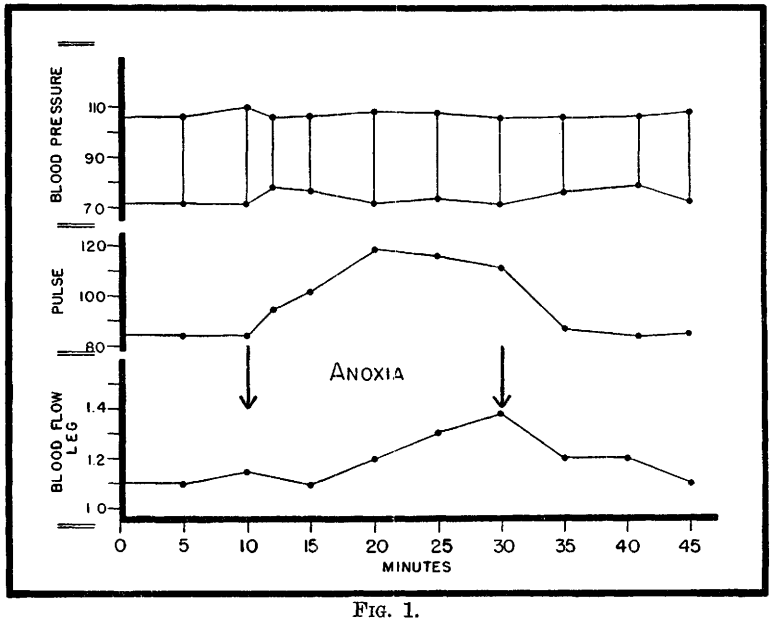

FIG. 1.

Effect of inhalation of 10.15 % oxygen mixture for period of 20 minutes (as indicated by interval between arrows). Blood flow in cc per min per 100 cc limb vol.

rarily reaching a lower level than that observed at the beginning of the experiment. The blood pressure for the most part showed no significant alteration during the period of anoxia. The respiration either increased an average of 4 per minute, or the respiratory movements were deepened without any alteration in rate.

From the foregoing, it appears that the inhalation of a 10% oxygen mixture, equivalent to an altitude of 20,000 feet, produced a moderate increase in the rate of resting peripheral blood flow. In respect to the hand, it is quite possible that the almost immediate decrease in flow was due to the apprehension associated with the procedure rather than to the anoxia *per se*, for it has been shown that the vessels in this region respond markedly to most psychic and noxious stimuli.[2] The observation that no change in blood flow was noted in the leg and forearm during the first 5 minutes of anoxia is readily understandable, since that period of time was probably required for the oxygen level in the blood to reach the new equilibrium with the oxygen in the mixture entering the mask. The fact that a greater than 50% decrease in oxygen content (from 20.9% in air to 10% in the mixture) produced only a moderate change in peripheral blood flow can also be easily explained, if one considers that in the normal subject under resting conditions, only a small proportion of the total quantity of oxygen in arterial blood is removed in passage through the muscle vessels. It would be expected, therefore, that during a state of moderate anoxia there would be no necessity for any marked increase in the rate of peripheral blood flow in order to satisfy the oxygen requirements of the resting tissues.

Summary. Inhalation of a mixture of 10% oxygen and 90% nitrogen produced a moderate increase in blood flow through the leg and forearm and a decrease through the hand. These changes in peripheral blood flow were associated with a significant augmentation in pulse rate, a slight increase in the amplitude or number of respirations and no definite change in blood pressure.

---

2 Capps, R. B., *J. Clin. Invest.*, 1936, **15**, 229; Kunkel, P., Stead, E. A., Jr., and Weiss, S., *J. Clin. Invest.*, 1939, **18**, 225; Abramson, D. I., and Ferris, E. B., Jr., *Am. Heart J.*, 1940, **19**, 541.