fine opening and containing KCl in agar. An even simpler way of "avoiding" KCl contamination in the solution of *known* pH is to prepare it saturated with KCl, in which case this bridge can be left in permanently. A further step is to seal the glass electrode to the calomel half cell and thus dispense with this KCl bridge. By this manoeuvre the half cell and the electrode form one piece.

After a little practice it is easy to blow the electrode oneself. In the construction of a stand, the arms which support the electrode and calomel cells are made of amber for insulation, but we find quartz more convenient. The only instruments one need purchase are a potentiometer of the usual type and an electrometer. We have used the Lindemann electrometer supplied by the Cambridge Instrument Company. The rest of the apparatus is easily made.

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3849

Changes in Lactic Acid and Glucose in the Blood on Passage Through Organs.

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The following research was undertaken to determine the factors regulating the concentration of lactic acid in the blood of mammals. Observations were made on 32 dogs most of which were decerebrate. The amount of lactic acid in the arterial blood was compared with that of the blood draining the liver, spleen, portal system, kidney, testicle, lower extremities, brain, thyroid, lungs and heart. Lactic acid was estimated by the method of Shaffer, Cotonio and Friedemann. Sugar was determined by the Shaffer-Hartmann method. A difference of 5 mg. % or more between the lactic acid content in the arterial and venous samples was considered significant. Typical results are found in Table I, where the muscle poured lactic acid in the blood stream and the liver removed it. Thus, in 27 of 51 observations the muscles added to the lactic acid content of the blood passing through them. In 19 cases the difference between arterial and venous blood was not considered signifi-

cant, and in 5 instances only did the muscles remove lactic acid. On the other hand, in 21 of 34 observations the liver removed lactic acid. However, in 6 instances the liver was adding lactic acid to the blood and therefore could not explain the lower arterial level. It is clear that some organ other than the liver was removing lactic acid. Results from many of the organs were not constant. Sometimes they would remove lactic acid from the blood though in decerebrate animals they usually added lactic acid.

TABLE I.
Changes in lactic acid and glucose in arterial blood and blood draining muscles, portal system and liver.

Date	Lactic acid mg. %				Glucose mg. %			
	Femoral Artery	Femoral Vein	Portal Vein	Hepatic Vein	Femoral Artery	Femoral Vein	Portal Vein	Hepatic Vein
Aug. 25	84.2	102.7	80.3	70.2	187	175	178	227
Dec. 3	88.6	113.2	88.7	65.8	166	162	157	174
Dec. 14	80.5	99.1	77.4	67.6	75	73	71	90

TABLE II.
Changes in lactic acid content of blood passing through the heart.

Date	Lactic acid mg. %	
	Femoral artery	Coronary vein
Dec. 22	61.8	55.3
	52.9	44.5
Jan. 17	41.0	30.2
Jan. 20	83.1	60.2
	131.8	117.4
Jan. 31	62.1	57.0

We next studied the heart. As seen in Table II the heart, in 6 observations, was removing lactic acid from the blood passing through it. Even small differences are significant in the heart because of its relatively large vascular supply.

Not only lactic acid but also glucose was determined on the blood samples. The organs with the exception of the liver usually removed glucose from the blood while the liver poured out increased amounts into the blood stream. There appears to be a cycle:

$$\text{Liver} \underset{\text{Lactic acid}}{\overset{\text{Glucose}}{\rightleftarrows}} \text{Muscle}$$

Summary. Changes in lactic acid and glucose content of the blood through organs have been studied in 32 dogs. The main source of lactic acid is the muscle while the organ chiefly concerned with its removal is the liver. The heart may participate in the removal of lactic acid from the blood. Since all the organs, with the exception

of the liver, remove glucose from the blood and the liver adds glucose there seems to be a carbohydrate cycle between muscle and liver, muscles sending lactic acid through the blood to the liver and the liver returning glucose to the muscles.

3850

Difference in Calcium Level of the Blood Between the Male and Female Cod.

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As far as we are aware, no reports have been made of calcium in the blood of fish. In the course of a study of various physiologic phenomena in the cod, a marked difference was found in the level of calcium in the blood of the male and the female. The percentage in the former was found to be approximately 9 to 12.5 mg., the cause of the variability not being ascertained. In the female a percentage as high as 29 was not uncommon, the lowest figure being 12.7 mg. These variations were due clearly to the generative state of the fish. When the roe was large and mature, the serum calcium percentage was high, whereas when the roe was hard, or after the fish was spent, the percentages were markedly lower. A similar relationship between spawning season and calcium level of the serum was found to exist in the puffer fish. Calcium in the female was found as high as 26 mg. %, whereas in the male it was about 12 mg. %. This phenomenon is not, however, common to all fish. For example, in the dog fish, a viviparous species, the calcium level was high in both male and female.

The inorganic phosphate was far more constant than the calcium. Generally it ranged between 9 and 12 mg. %, the former amount having been obtained in a female cod which had 17.8 mg. % of calcium in the blood. The highest figure was 14.7 in a female with 13.3 mg. % of calcium. From these figures, it is evident that the inorganic phosphorus does not bear a definite ratio to the percentage of calcium. Nor does it vary with the spawning season, a fact which is emphasized by an instance in which a female with a calcium percentage of 29 mg. in the blood had a percentage of inorganic phosphorus of only 10.9 mg.

The total cholesterol content of the blood varied within wide