least in part, to geographical segregation. If further studies should show that there is segregation, geographical or ecological, between these forms, then they are *species;* if not, they are *varieties,* which fact then also will be expressed in their morphological condition, one form running into the other at least in certain parts of their ranges.

A. E. ORTMANN

CARNEGIE MUSEUM,
PITTSBURG, PA.,
November 23, 1907

SPECIAL ARTICLES

CARBOHYDRATE METABOLISM

WHEN we consider the fact that the products of the oxidation of sugars *in vitro* are not well known, the uncertainty that prevails regarding the mechanism of utilization of the common sugars in the body can be understood. Not only are the products of their metabolism unknown, but the form in which the carbohydrate must reach the cell to be available as a food is also not beyond dispute. It is ordinarily held that the cell can utilize sugar as such. On the other hand, some hold that the sugar must reach the cell in a colloid form or combination to act as a food. Again, it is claimed that dextrose is the form in which sugar is utilized by the tissues, and that the other sugars, as levulose or galactose, are transformed into dextrose before they are oxidized. The present preliminary report aims to give the results of some work on this problem.

The method adopted consists essentially of perfusing an organ with blood containing a known quantity of the sugar under investigation, and determining the loss after perfusion. The weight of the organs before and after perfusion is taken into account; the loss in volume of the perfused liquid; the gain in weight of the organ and the total carbohydrate before and after perfusion. In this way the quantity utilized by the organ may be determined. Perfusion was also done in dead organs to see that the mechanical construction had nothing to do with the loss of sugar. Also samples of the liquid were kept at the temperature of the perfused blood (37–40° C.) during the time of perfusion to ascertain the extent of glycolysis occurring without perfusion.

A very brief summary of results will be given:

Experiment I.—Perfusion of the hind legs of a dog with dextrose-blood solution. The legs were stimulated at 30 times per minute and the perfusion was made at the rate of about 125 c.c. in ten minutes.

	Dextrose per mille.
Blood before perfusion	3.1916
Blood after 20 minutes	2.9659
Blood after 30 minutes	2.7750
Blood after 45 minutes	2.4736
Blood after 65 minutes	1.9473
Blood after 71 minutes	1.5384

It is readily seen that a loss of sugar has taken place. This loss could occur in one of several ways: (1) by actual oxidation; (2) by accumulation in the surrounding tissues; (3) by storage in the tissues as glycogen, etc.; or (4) by absorption by the tissues. As a result of a number of experiments it has been found that both oxidation and accumulation take place. In every instance there was a distinct loss of dextrose when perfused through the living tissue. The accumulation by edema and other means increased as the tissues died, and in the dead organs an accumulation took place without any oxidation.

When the liver was perfused, there was likewise a loss of sugar. No glycogen storage occurred unless the perfusion was commenced very rapidly after the interruption of the circulation. In other words, the glycogen-storing function of the liver was lost much more quickly than the glycolytic function. No definite conclusions could be drawn as to the influence of the hepatic circulation when perfusion was made through the hepatic artery, simultaneously with the perfusion through the portal, the ordinary method used.

The utilization of levulose: What has been said of dextrose will hold good for levulose. A brief summary of results with this sugar will illustrate.

Weight of perfused leg	1,000	gms.
Weight of muscles of same	610	"
Weight of opposite leg	1,020	"

Total carbohydrate in leg before perfusion (glycogen and sugar) (.12 per cent.)	1.260 gms.
Total carbohydrate in leg after perfusion (.1645 per cent.)	1.645 "
Gain	.3850 "
Total volume blood used in perfusion	500 c.c.
Content of sugar at beginning (.5472 per cent.)	2.7160 "
After four perfusions (2 hrs., 30 mins.) blood remained after samples were taken for analysis	310 c.c.
Amount of sugar this contained (.4348 per cent.)	1.3478 "
Total loss of sugar in blood	1.3682 "
Sugar recovered from samples	.3508 "
Recovered by difference in muscles at end	.3850 "
Sugar loss by oxidation	.6324 "

If the amount of dextrose in the original blood be calculated at one part per thousand there would be at least .3204 gm. of levulose used by the muscles, granting that the dextrose be utilized before the levulose, an assumption which has no facts to support it.

A second experiment carried out in the same way where the sugar at the beginning was .8620 per cent. at the end of the perfusion of over four hours' duration contained .3360 per cent. The total loss of sugar was 1.0997 gm. Dextrose content at beginning was .0801 per cent. Loss of levulose at least .7693 gm. The results show that levulose as dextrose is attacked directly by the living tissues. If there be a conversion of either into glycogen it takes place in the muscle as it is oxidized, which is highly improbable.

Maltose is not used directly by the muscle. There is some loss of sugar, but if we assume that the dextrose in the blood is utilized in preference to maltose, no reduction of the quantity of maltose takes place. If we grant that both are used equally there could be at most only a slight reduction of the maltose. Some interesting features in connection with the vitality of the muscles are brought out in maltose perfusions, *e. g.*,

	Per Cent.
The blood after addition of maltose	.6325
The blood after 30 minutes (first perfusion)	.5720
The blood after 68 minutes (fifth perfusion)	.5720
The blood after 4 hrs., 16 mins. (fourteenth perfusion)	.4720
Sugar in non-perfused leg	.0500
Sugar in perfused leg at end of experiment	.2250

The total sugar recovered is almost equal to that at the beginning. Between the fifth perfusion and the fourteenth the reaction to stimulation decreased markedly, and the transudation of the sugar into the muscles appeared to occur *pari passu* with the loss of the vitality of the muscle. The loss of sugar in the first thirty minutes was less than the dextrose content of the blood at the beginning. The loss thereafter was very slight.

Investigation of the other sugars has not been concluded.

Hugh McGuigan
Washington University
Medical School

QUOTATIONS

The Committee of One Hundred

One of the largest and most enthusiastic of the sectional meetings of the American Association for the Advancement of Science, recently held in Chicago, was the Symposium on Federal Regulation of Public Health, held by the Economic Section in conjunction with the Committee of One Hundred on National Health, and representatives from other great organizations. The opening address was by Professor William H. Welch, the retiring president of the American Association for the Advancement of Science, and in it he emphasized the importance of the movement conducted by the Committee of One Hundred. He described the existing neglect of health as shameful, and pointed out that, if existing hygienic knowledge were fully applied, the death-rate might be cut in two. As examples of what a Federal Health Bureau might do he cited the work of Pasteur and Koch, whose best work was done for the national governments of France and Germany, though the benefits have been shared by all nations. In America we lack even the statistics of disease except in a limited area. Professor F. F. Wesbrook, the dean of the Medical School of the University of Minnesota, showed the need