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cycles and their autographs. The radioactivity was low on this slide so that the spots are not as clear as in the former autographs. However, the spots are tagged as before. These slides, as well as previous work, have not led to a definite conclusion. Definite clearly defined spots will be necessary to apply any statistical method.

Reproduction of a spot in the two series of cycles would indicate some critical point—nonuniformity of the slide surface to cause a droplet of water to hang at the same place in the two series. If such a critical point exists the conditions of the cycle at the time for formation of the spot may cause the drop of water in one series to extend to one side and to the other in the next series. The shape of the spot in the two series might well be different. In fact it would be surprising if they were the same. Thus, comparison is not merely a matter of superimposing the two negatives on a viewing box and noting which spots match. It will have to be decided if two overlapping spots could come from the same critical point.

There are several ideas as to how to attack this comparison but, until slides have been obtained that are sufficiently clear, we feel the attempt is not worthwhile. Our impression is that we will not find the memory for spots.

Photographs have been presented that, at least for our particular set of conditions, have shown that the mineral spots persist from cycle to cycle both as to position, shape and detail. Autograph spots of the radioactive fat generally are reproductions of the mineral matter. It has been indicated that fat and protein along with the water hardness are necessary for persistence of a spot.

Photographs and autographs of two series of cycles of the same slides have been inconclusive to show a reproducibility of spot position from the first series to the second.

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BIOPHYSICAL APPLICATIONS OF THE MASS SPECTROMETER

JOSEPH A. ANDERSON and EDWARD J. BALDES

Mayo Clinic and Mayo Foundation, Rochester, Minnesota

ABSTRACT

The mass spectrometer at the Mayo Clinic has been used for analysis of several anesthetic agents in blood (Jones and associates, 1953; Hattox and associates, 1953) and for carbon dioxide and oxygen studies in blood (Patrick and associates, 1954). The latest program for which the mass spectrometer has been used is that of employing heavy water as a tracer for determination of absorption rates in the gastrointestinal tract of human subjects. Blood samples containing small concentrations of D_2O (heavy water) must be converted to the

gas phase before being analyzed by the mass spectrometer. On the mass spectrometer the mass 3/mass 2 ratio is determined and this ratio is expressed in terms of moles per cent D_2O by means of calibration with five standards.

This paper discussed the zinc reduction method (Rittenberg and Graff, 1952; Solomon and associates, 1950) of converting the liquid samples to the gas phase, the sources of error in reduction, and some of the results obtained.

In the reduction train, 30-mesh granular zinc is heated to $400^\circ C$. in a pyrex glass tube by means of an electric furnace. A liquid sample of about 0.005 ml. is placed in the reduction system. The sample is quickly frozen, and the air over the liquid is pumped off. The sample is connected to the hot zinc and, as it thaws, the vapor passes over the hot zinc and reduction takes place. The reaction is carried to completion, and the gas is displaced into a sample bulb by means of a Toepler pump arrangement.

The errors can be summarized as being due to contamination, memory effects and fractionation. The over-all accuracy of analysis is usually within 2 per cent when the sample concentration is within the range of our calibrating standards.

In an experiment, D_2O is placed in the stomach or small bowel and arterial blood samples are taken at short time intervals. A curve showing the appearance rate of D_2O into the blood (Code and associates, 1954) and other body fluids is obtained when the D_2O concentration of the samples is plotted against the corresponding times at which the samples were taken. This type of curve shows only qualitative aspects of absorption. Equilibrium time occurs usually after $2\frac{1}{2}$ to 3 hours. The total body water content can be found when the equilibrium concentration and the amount of D_2O given are known.

In order to determine the actual quantities of D_2O absorbed (Scholer and Code, 1954), the volume dilution as well as the concentration of the blood must be known. The volume dilution is found by means of a mean arterial disappearance curve of isotonic D_2O injected intravenously. A "longhand" method must be used for purposes of integration of the disappearance curve and the appearance curve to obtain the quantity of D_2O absorbed during finite time intervals. The "longhand" method is necessary since, although the disappearance curve can be described mathematically, the appearance curve is variable and cannot be so described. Both the appearance curve and the disappearance curve are divided into small time increments. Volume dilutions are found for time intervals on the appearance curve from corresponding time intervals on the mean disappearance curve.

It is seen that the appearance of the absorption curves for the small bowel is characterized by rapid rates, while the stomach curves show a decidedly slower rate. The mean initial rates of absorption from the stomach and small bowel are 2.5 per cent per minute and 26.1 per cent per minute, respectively.

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EXHAUSTIVE EXTRACTIONS OF A MINNESOTA PEAT

MOSES PASSER

University of Minnesota, Duluth

In 1937 a group of Irish workers¹ carried out a comprehensive study of the extraction of waxes from an Irish peat by various pure solvents and solvent mixtures. In this work they used only such solvents as can form azeotropes with each other, and each mixture had the azeotropic composition. (This decision was based on the fact that under continuous Soxhlet-extraction conditions, only an azeotrope will have constant composition, both of the liquid and vapor, and thus be capable of affording reproducible results. In fact, in many non-azeotropic mixtures whose components differ substantially in their boiling points, there is sufficient fractionation that only the more volatile member can even reach the extraction thimble, so that an extraction by such a "mixture" is really nothing more than an extraction by a single solvent.) Most of the common solvents then commercially available were used in this research. The yield of waxes varied from

¹ J. Reilly, D. F. Kelly, and D. J. Ryan, J. Soc. Chem. Ind. 56, 231T (1937).