Die zu erwartende Zeitkonstante von etwa 10 s wurde mit dem Vorverstärker und 3 mm starkem Bariumtitanat, siehe Abb. 3 *B* – 8 s –, fast erreicht. Die Verwendung dünnerer Bariumtitanat-Scheibchen aus dem gleichen Material würde die Zeitkonstante verlängern.

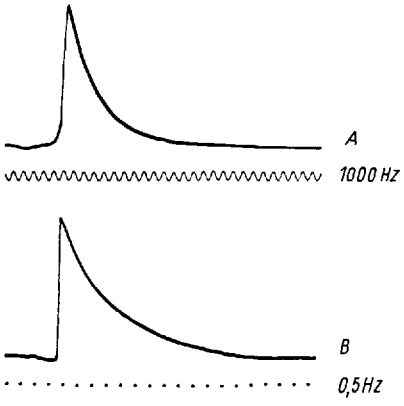

Abb. 3. Zeitkonstanten der Registriereinrichtung: *A* ohne Vorverstärker; *B* mit Vorverstärker.

Demnach lassen sich mit der beschriebenen Anordnung und geeignet dimensioniertem Bariumtitanat-Geber Druckänderungen bis zu einer Sekunde Dauer mit einem Fehler von höchstens 10% registrieren. Steht ein Verstärker genügender Empfindlichkeit zur Verfügung oder sind die Druckänderungen gross, so kann eine Parallelkapazität zur kapazitiven Spannungsteilung verwendet werden. Diese verlängert die Zeitkonstante des Registriersystems im gleichen Verhältnis, wie sie die Spannung herabsetzt. Eine Beeinflussung des Frequenzganges tritt dadurch, wie aus dem Ersatzschaltbild zu entnehmen ist, nicht ein. Zu hohe Spannungen, über 10 V, würden den Eingangswiderstand des Vorverstärkers herabsetzen.

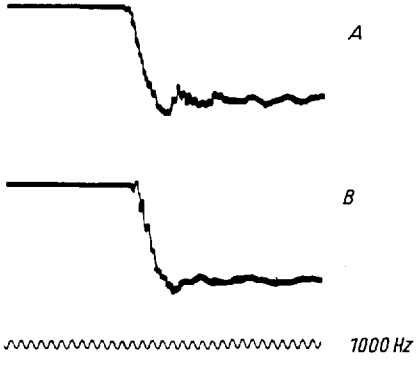

Abb. 4. Druckänderung bei explosiver Dekompression: *A* Bariumtitanat-Geber mit Vorverstärker; *B* Bariumtitanat-Geber mit Vorverstärker und Parallelkapazität.

In Abbildung 4 sind zwei Dekompressionskurven dargestellt, die einer Druckdifferenz von 0,7 atm entsprechen. Abbildung 4*A* wurde nur mit Bariumtitanat-Geber und Vorverstärker, Abbildung 4*B* mit einer zusätzlichen Parallelkapazität von 10 nF aufgenommen. Die Kurven entsprechen einander bis auf geringe Differenzen, die in den Dekompressionsvorgängen selbst begründet sind.

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Summary

The properties and advantages of barium titanate transducers for pressure registrations have been described. If the rate of pressure change is less than 10^{-3} s, a barium titanate transducer with a cathode ray oscilloscope as commonly used is sufficient. Pressure changes with a duration of up to 1 s can be recorded by means of a barium titanate transducer, cathode follower with open grid, and D.C. oscilloscope. This arrangement can be adapted to the registration of processes of even longer duration by a shunt capacity. The sensativity of the transducer used was in the order of 2 V per 1 atm.

PRO EXPERIMENTIS

A Contribution to the Evaluation of the Glucose Tolerance Test

In recent years several authors have begun administering glucose intravenously instead of *per os*, even in clinical practice, in order to determine the carbohydrate tolerance. There are several ways of evaluating the result of intravenous glucose tolerance test: (1) the hyperglycaemic peak attained and the return to the fasting value[1], (2) the value of the blood sugar at a given interval after the end of the injection[2], (3) the time taken for the blood sugar to regain the fasting value[3] or the time taken to reach a definite pre-determined value[4], (4) the glucose assimilation coefficient[5], rate of disappearance of the glucose[6], total or increment index[7], (5) the areas under the observed curves[8], (6) the quantity of sugar utilised per 1 h[5], (7) the clearance of glucose suggested by HOENIG[9]. The formula he proposes for the glucose clearance does not take into account the initial phase of rapid decline and presumes that the blood sugar level during the course of the glucose tolerance test is maintained at the fasting value. In the present work we propose an altered form of the equation for the calculation of clearance of glucose.

Method. The glucose tolerance test was performed on 13 healthy adults and 39 ambulant patients. On the night before the test 50 g of glucose were administered *per os* for compensating for inequalities in the diet[10]. The following morning the sample of blood was taken and 25 g of glucose were injected intravenously in a 40% solution of distilled water during 2½ to 4 min. Blood samples were drawn from the finger in 5, 10, 20, 30, 45,

[1] G. G. DUNCAN, *Diseases of metabolism*, III. Ed. (Philadelphia 1953). – A. CANTAROW and M. TRUMPER, *Clinical Biochemistry* (Philadelphia 1949).

[2] E. L. LOZNER, A. W. WINKLER, F. H. L. TAYLOR, and J. P. PETERS, J. clin. Invest. *20*, 507 (1941).

[3] E. R. TUNBRIDGE and E. C. ALLIBONE, Quart. J. Med. *9*, 11 (1940).

[4] T. CRAWFORD, Arch. Dis. Child. *13*, 69 (1938).

[5] V. CONARD, *Mesure de l'assimilation du glucose* (Bruxelles 1955).

[6] D. S. AMATUZIO, F. I. STUTZMAN, J. M. VANDERBILT and S. NESBIT, J. clin. Invest. *32*, 428 (1953). – G. D. GREVILLE, Biochem. J. *37*, 17 (1943). – J. J. WALLER, S. H. STRIBLING and CH. L. SPUR, J. lab. clin. Med. *44*, 647 (1954).

[7] L. J. P. DUNCAN, Quart. J. exp. Physiol. *41*, 85 (1956).

[8] S. JÖRGENSEN, Acta med. Scand. *65*, 116 (1926–1927). – C. W. Ross, Arch. Dis. Child. *13*, 289 (1938).

[9] V. HOENIG, Čas. lék. čes. *95*, 122, 1015 (1956).

[10] T. N. BURNS, F. L. ENGEL, E. WERK, A. VIAV, J. L. SCOTT, and D .R. HOLLINGSWORTH, J. clin. Invest. *32*, 781 (1953). – J. A. MIRSKI, S. M. KAPLAN, C. J. PODOVE, and R. H. BRON-KAHN, J. clin. Invest. *29*, 297 (1950).

60, 75, 90 min intervals and blood sugar was determined according to our own modification of the anthrone method[11]. In the 60th and 120th min urine was collected for the determination of sugar by the anthrone method. During the whole procedure the patients remained in a recumbant posture. When blood sugar concentration was plotted against time on semilogarithmic paper, a straight line was obtained (Fig. 1).

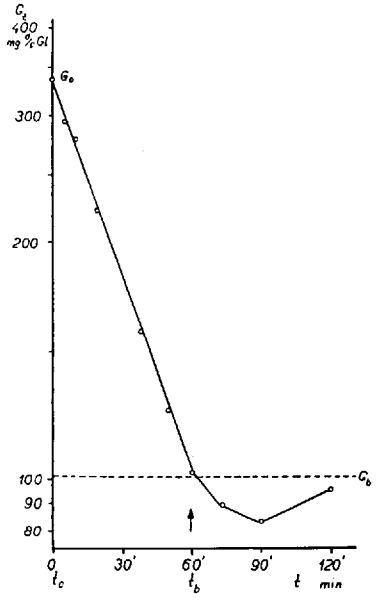

Fig. 1.—The decline of concentration of the blood sugar plotted against time on semilogarithmic paper. G_0 is the blood sugar level at the end of the injection. G_b is the fasting value, t_b the time in which the blood sugar regains the fasting level.

Results. In evaluating our tolerance tests by means of clearance values we were guided by the following consideration. In the organism the volume V at the fasting level G_b contains $V \cdot G_b$ of glucose. After administering intravenously a quantity I of glucose there is in the whole organism $I + V \cdot G_b$ of glucose at the end of the injection. Since SOSKIN[12], BONDY[13] have shown that there is no output of sugar from the liver after a dose of glucose (Fig. 2) and therefore the level G_b does not remain constant as is presumed in the formula proposed earlier, the quantity $I + V \cdot G_b$ is utilized by tissues of the whole organism and the glucose concentration level declines according to the exponential equation[5]

$$G_t = G_0 e^{-kt} \tag{1}$$

where G_t is the blood sugar level in the time t, G_0 is the blood sugar value in the time $t_0 = 0$, K the rate of disappearence of the glucose. This relation holds up to the moment the liver starts anew to give out sugar, that is to say approximately the moment when the concentration falls to G_b during time t_b (Fig. 2). Then the quantity of glucose in the organism will be again $V \cdot G_b$.

$$V \cdot G_b = I + V \cdot G_b - Qv \tag{2}$$

where Qv is the quantity of glucose utilized during the time t_0–t_b.

$$Qv = V \int_{t_0}^{t_b} dG = V \cdot (G_0 - G_b). \tag{3}$$

By inserting (3) into the equation (2) we have

$$I = V \cdot (G_0 - G_b). \tag{4}$$

The formula for Cl defined by NEWMAN[14], LEWIS[15], NAVA[16] is:

$$Cl = 2{,}303 \cdot V \cdot \frac{\log_{10} G_0 - \log_{10} G_b}{t_b - t_0} = V \cdot K \tag{5}$$

where K is the rate of disappearence of the substance studied[17], which is obtained by expressing the equation (1) logaritmically. By combining equation (4) with (5) we get the final formula

$$Cl = \frac{I \cdot K}{G_0 - G_b} \text{ ml/min} \tag{6}$$

where I is the quantity of glucose given minus the quantity of glucose excreted by urine in 60 min, which time represents the average of declines to the fasting value. G_0 is the blood sugar level in the time t_0 obtained by extrapolating the straight line, G_b is the fasting blood sugar value, K is the rate of disappearence of glucose[18] and $K = \log_e 2/t_h$ where t_h is the time in minutes required for the blood glucose value G_0 at any point to be halved.

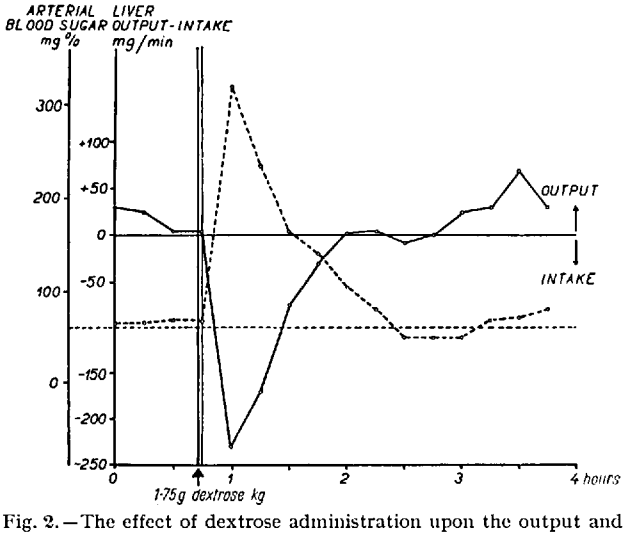

Fig. 2.—The effect of dextrose administration upon the output and intake of sugar by liver of an intact dog, calculated from blood sugar values and thermostromuhr measurements of hepatic blood flow. The broken line represents arterial blood sugar values; the heavier, continuous line represents output or intake of sugar by the liver in milligrams per minute (SOSKIN *et al.*[19]).

In support of the use of the above formula (4) as substitute for the volume, we point to the findings of Co-

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[12] S. SOSKIN and R. LEVINE, *Carbohydrate metabolism* (Chicago 1952). – S. SOSKIN, H. E. ESSEX, J. F. HERRICK, and F. C. MANN, Amer. J. Physiol. *120*, 761 (1937).

[13] P. K. BONDY, D. F. JAMES, and B. W. FARRAR, J. clin. Invest. *28*, 238 (1949).

[14] E. V. NEWMAN, J. BORDLEY, and J. WINTERNITZ, Johns Hopk. Hosp. Bull. *75*, 244 (1944).

[15] G. NAVA and P. CAMPA, Riv. Gastro-enterol. *2*, 75 (1950).

[16] A. E. LEWIS, Amer. J. clin. Pathol. *18*, 789 (1948).

[17] V. CONARD, *Mesure de l'assimilation du glucose* (Bruxelles 1955). – D. S. AMATUZIO, F. I. STUTZMAN, J. M. VANDERBILT, and S. NESBIT, J. clin. Invest. *32*, 428 (1953). – G. D. GREVILLE, Biochem. J. *37*, 17 (1943). – V. HOENIG, Čas. lék. čes. *95*, 122, 1015 (1956).

[18] V. CONARD, *Mesure de l'assimilation du glucose* (Bruxelles 1955). – D. S. AMATUZIO, F. I. STUTZMAN, J. M. VANDERBILT, and S. NESBIT, J. clin. Invest. *32*, 428 (1953). – G. D. GREVILLE, Biochem. J. *37*, 17 (1943). – L. J. P. DUNCAN, Quart. J. exp. Physiol. *41*, 85 (1956). – V. HOENIG, Čas. lék. čes. *95*, 122, 1015 (1956).

[19] S. SOSKIN, H. E. ESSEX, J. F. HERRICK, and F. C. MANN, Amer. J. Physiol. *120*, 761 (1937).

NARD[5] who compared the extracellular volume calculated from the course of the glucose tolerance test and by the SCN method and arrived at similar results. We evaluated our own intravenous glucose tolerance tests and those from literature[20] by means of the new and by HOENIG's method as well. The values of *Cl* were plotted against *K*. A better correlation was found between *K* and *Cl* as determined by the new formula (Fig. 3). The values of *Cl* also depend on the volume of distribution,

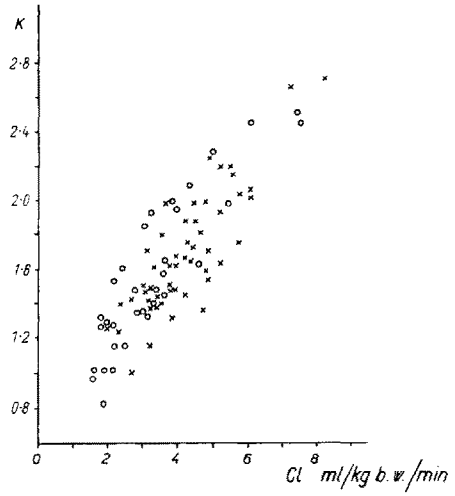

Fig. 3.—The clearance of glucose is plotted against the rate of disappearance $K \times 10^2$.

are inversely proportional to the time in which the blood sugar value declines to the fasting level and to the $\log_e$ of the concentration found after 60 min. The average value $K \times 10^2$ of healthy adults, similary as in CONARD's series[5] is 1·69 ± 0·27, the mean values for *Cl* are: Cl_{total} 220·56 ± 54·9 ml/min and for unit of weight 3·29 ± 0·92 ml/min/kg b.w.

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Zusammenfassung

Es wird eine abgeänderte Formel für die Berechnung der Glukose-Clearance nach intravenöser Applikation vorgeschlagen.

Das arithmetische Mittel und die Standardabweichung der Clearancewerte bei Gesunden betragen 220,56 ± 54,9 ml/min, das heisst 3,29 ± 0,92 ml/min/kg Körpergewicht.

[20] V. CONARD, *Mesure de l'assimilation du glucose* (Bruxelles 1955). – D. S. AMATUZIO, F. I. STUTZMAN, J. M. VANDERBILT, and S. NESBIT, J. clin. Invest. *32*, 428 (1953).

PRO EXPERIMENTIS

The Determination of Volatile Aldehydes in Gases and Vapours

In the analysis of gaseous mixtures, a very accurate process is seldom necessary to determine volatile aldehydes such as acetaldehyde, propionaldehyde, and n-butyraldehyde. The present note gives a very precise method, as far as we know not yet described in the chemical literature, for the determination of such vapours in presence of volatile saturated and unsaturated hydrocarbons, carbon dioxide, carbon monoxide, oxygen and nitrogen, using an Orsat apparatus. The process consists in bubbling the mixture of gases through an absorption solution described below.

The experiments necessary to determine the selective absorption of the aldehydes were made in the following manner:

Liquid acetaldehyde, propionaldehyde or butyraldehyde, distilled with a fractional distillation column with fourty theoretical plates, were introduced into a gas sampling pipette, filled with clean and dry mercury. The level of mercury can be lowered by lowering the bulb attached to the inferior part of the pipette, thus vaporizing the aldehyde.

The pure aldehyde vapour was then introduced into the volumetric burette of the Orsat apparatus, its volume read at atmospheric pressure and then the other gases were introduced under the same conditions and their volumes recorded.

The known volume of the gaseous mixture was then bubbled several times through the solution below proposed for aldehydes absorption, until the difference between two volumes determinations was equal to the experimental error. Usually only 4 to 5 slow passages each involving 3–5 min are necessary.

After the absorption of the aldehyde, the residual mixture is passed through other absorption solutions in order to effect the selective absorption of the other gases. The preparation and composition of the absorption solutions that we have used are well described by BURKE, STARR, and TUEMMLER in their book[1].

The results obtained with mixtures containing from zero to 50% in volume of acetaldehyde, zero to 32% in volume of propionaldehyde and zero to 6% in volume of butyraldehyde, were very good, given results affected always with errors less than ± 0,1.

In all the experiments the absorption mixtures were previously saturated with the gases analyzed, as is commonly done in the gas analysis technique. Beside these experiments, we studied the absorption of the following gases mixed with air and found total recovery of them. Gases tested:

CH_4, C_2H_6, C_3H_8, C_2H_4, C_3H_6, C_2H_2, CO_2, CO, N_2, H_2 and O_2.

Preparation of the absorption solution.—15 g of 98% sulfuric acid were dissolved in 220 ml of a saturated solution of sodium sulfate (at 20°C), and 46 g of chromium trioxide were then introduced. The orange-red solution so obtained is ready for use after the necessary saturations.

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Zusammenfassung

Es wird eine neue Methode vorgeschlagen, Acetaldehyd, Propionaldehyd und Butyraldehyd in Gegenwart von CH_4, C_2H_6, C_3H_8, C_2H_4, C_3H_6, C_2H_2, CO_2, CO, N_2, H_2 und O_2 quantitativ zu bestimmen. Die Methode besteht darin, das Gasgemenge mit Hilfe eines Orsatschen Apparates durch eine bei 20°C gesättigte, Chromtrioxyd und Schwefelsäure enthaltende Natriumsulfatlösung zu schicken, welche die oben genannten Aldehyde selektiv absorbiert.

[1] O. W. BURKE, C. E. STARR, and F. D. TUEMMLER, *Light hydrocarbon analysis* (Rheinhold Publ. Co., New York 1951), Method LH-302-304.

[2] Present address: Chemistry Department, Northwestern University, Evanston (Illinois).