quite definitely that in all cases studied the reaction is faster for the heavy compound.

TIMES OF ONE-HALF REACTION (IN MIN.)

Catalyst	Temp., °C.	$C_2H_2D_2$	C_2H_4
Nickel	+64	13	28
Platinum	−21	12	18
Cobalt	0	2.8	3.5

The columns give the nature of the catalyst, the temperature of the experiment, the time of half reaction for the heavy and light compound.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LOUVAIN
LOUVAIN, BELGIUM

RECEIVED JULY 21, 1938

Some Phenacyl and *p*-Substituted Phenacyl Esters

BY R. V. LUNDQUIST

Some phenacyl and *p*-substituted phenacyl esters of organic acids have been prepared for the identification of those acids. They were prepared by the method of Judefind and Reid.[1]

Heptylic Acid.—The phenacyl ester was a liquid.

Dichloroacetic Acid.—The phenacyl ester was a liquid; the *p*-bromophenacyl ester, observed m. p. 98.2 to 99.3°; the *p*-chlorophenacyl ester, observed m. p. 93.0 to 93.8°.

***α*-Bromo-*n*-butyric Acid.**—The phenacyl ester was a liquid; the *p*-phenylphenacyl ester, observed m. p. 103.5 to 104.0°.

Acetylsalicylic Acid.—The phenacyl ester, observed m. p. 105.0 to 105.5°.

The esters were obtained in excellent yield and the solid esters were purified easily to a constant melting point.

[1] Judefind and Reid, THIS JOURNAL, **42**, 1043 (1920).

CONTRIBUTION FROM THE
CHEMISTRY LABORATORY
UNIVERSITY OF IDAHO
MOSCOW, IDAHO

RECEIVED MAY 25, 1938

Acid Dissociation Constants in Dioxane–Water Mixtures. A Correction of the Dissociation Constant of Benzoic Acid

BY CECIL C. LYNCH AND VICTOR K. LA MER

Professor Martin Kilpatrick and Dr. L. John Minnick of the University of Pennsylvania kindly called our attention to the fact that the dissociation constants of benzoic acid as given in the "International Critical Tables," Vol. VI, p. 279, are in error by a factor of ten and that this had led to an unnecessary restriction of statement in our paper of the above title.[1] When the most recent value for 25°[2] is plotted in our Fig. 8 instead of the erroneous "I. C. T." value (6.15×10^{-4}), the anomalous behavior of benzoic acid as compared with acetic, propionic and butyric acids disappears. Log K_{benzoic} becomes a linear function of the reciprocal of the dielectric constant between $D = 78$ and 21, and now conforms closely to the behavior of the three aliphatic acids. In Table III, p. 1257, K_{acetic} ($D = 34.3$) should read 5.62×10^{-7} instead of 5.01×10^{-7} and the second datum for propionic acid ($D = 21.0$) should read 5.33×10^{-9} instead of 5.30×10^{-9}.

[1] Lynch and La Mer, THIS JOURNAL, **60**, 1252 (1938).

[2] 6.31×10^{-5}, Brockman and Kilpatrick, *ibid.*, **56**, 1483 (1934).

DEPARTMENT OF CHEMISTRY
COLUMBIA UNIVERSITY
NEW YORK, N. Y.

RECEIVED JUNE 23, 1938

The Hydrolysis of Methyl Iodide

BY RICHARD A. OGG, JR.

The hydrolysis of methyl iodide in pure water[1] has been shown to be kinetically first order with respect to methyl iodide, and unretarded in rate by the resulting hydriodic acid. Essentially similar results have been found by the author in a brief study of methyl iodide hydrolysis in a mixture of equal volumes of anhydrous methanol and water. The solutions (some 0.02–0.08 molar in methyl iodide) were heated in sealed nitrogen-filled tubes. Reaction was followed by titration of the resulting hydriodic acid. The last stages of the reaction were complicated by formation of considerable iodine (Moelwyn-Hughes found only traces)—undoubtedly as a result of the side reaction $CH_3I + H_3O^+ + I^- \longrightarrow CH_4 + I_2 + H_2O$. (The solutions containing most iodine gave off inflammable gas on opening the tubes.) Displacement of the equilibrium

$$CH_3OH + H_3O^+ + I^- \rightleftarrows CH_3I + 2H_2O$$

to the right by the large concentration of methanol in the solvent explains the importance of the side reaction—as contrasted to the results in pure aqueous solution.

Very good first order rate constants were obtained up to some 60% completion of the reaction (iodine formation then became troublesome). At 100 and 55° the rate constants were found to be, respectively, some 3×10^{-4} (average from

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[1] E. A. Moelwyn-Hughes, *Proc. Roy. Soc.* (London), **A164**, 295 (1938).

three runs, with following respective sets of constants corresponding to successive time intervals—3.1, 2.9, 3.0, 3.1, 3.2, 3.1, 3.0, 3.1; 2.9, 3.0, 2.8, 3.0) and 3.2×10^{-6} sec.$^{-1}$ (average from two runs, with following respective sets of constants—3.3, 3.4, 3.2, 3.1; 3.1, 3.0, 3.2, 3.1). The corresponding values found by Moelwyn-Hughes for the reaction in aqueous solution are 4.47×10^{-4} and 4.9×10^{-6} sec.$^{-1}$. The effect of replacing a portion of the solvent water by methanol is thus to diminish the rate of methyl iodide hydrolysis. Comparison of the figures at the respective temperatures indicates that the activation energy is but slightly affected, if at all. These results are entirely similar to the effects of solvent change on the rates of hydrolysis of secondary and tertiary alkyl halides in mixtures of ethanol and water.[2] It would appear that the hydrolyses by *neutral water* of methyl halides are kinetically similar to the corresponding reactions of secondary and tertiary halides, and that an identical intimate mechanism obtains for all of these reactions.

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[2] See E. D. Hughes, *Trans. Faraday Soc.*, **34**, 185 (1938), for a review of this field.

CHEMICAL LABORATORY
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RECEIVED JUNE 13, 1938

A New and Direct Method for the Determination of Creatine. I. Preliminary Report

BY CHARLES F. SCHAFFER

Investigations on the origin and significance of the excretion of creatine in the urine have received no general acceptance. The reason for this uncertainty is that creatine is not determined directly, but by difference. The preformed creatinine is determined by Folin's colorimetric method, and then the urine is heated with acid which converts the creatine to creatinine. The creatinine is then redetermined. The difference between this total creatinine value and that of the preformed creatinine is called creatine. The fallacies of such an analytical procedure are obvious; especially when considering that the quantitative determination of creatinine itself is made by measuring its reducing action. In fact it has been pointed out independently by Arnold,[1] Emden,[2] Hurtley,[3] Greenwald[4] and confirmed by Graham and Poulter,[5] that acetoacetic acid is capable of showing a false presence of creatine.

In attempting to formulate a copper reagent that would eliminate entirely the effect of reducing nitrogenous substances, but still retain its maximum ability to be reduced by sugars, Folin and Svedberg[6] developed one which is reduced by nitrogenous substances such as uric acid, creatine, creatinine and allantoin, but is not affected by sugar.

It was the use of this reagent which enabled Larson[7] to promulgate his colorimetric method for the determination of allantoin.

The subsequent use of this procedure for the determination of added allantoin in urine of man resulted in the recovery of excessive amounts. On investigation it was found that the substance responsible for this greatly increased reducing action was creatine.

Aware of the negligible amounts of allantoin present in human urine, it was decided that an earnest endeavor to utilize this procedure for the determination of creatine warranted investigation. It was soon discovered that by increasing the alkalinity of the copper solution, creatine demonstrated reducing properties which varied directly as its concentration and could be measured quantitatively.

Larson's procedure, slightly modified for its adaptation to creatine, is used. The determination is made by treating a portion of the filtrate of the test sample in a Folin–Wu[8] sugar tube with the ammoniacal copper solution; the alkalinity is increased by the addition of sodium hydroxide solution, and immediately it is placed in a rapidly boiling water-bath for ten minutes, cooled and the blue color, developed after the addition of acid molybdate, compared with a 1-mg. creatine standard similarly treated.

Reagents Required

Phospho-24-tungstic Acid.—It is essential that the phosphotungstic acid used be pure. Larson obtained inconsistent results in the precipitating power of eight different lots of C. P. phosphotungstic acid procured from four leading manufacturers and the results have been substantiated in this Laboratory. Basic lead acetate;[9] 5% (by weight) sulfuric acid solution; Folin ammoniacal cop-

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[1] Arnold, *Zentr. inn. Med.*, **21**, 417 (1900).

[2] Emden, *Zentr. Stoffenechael, Verdauungs-Krankheiten, N. F.*, **2**, 250–289 (1907).

[3] Hurtley, *Lancet*, **184**, 1160 (1913).

[4] Greenwald, *J. Biol. Chem.*, **14**, 87 (1913).

[5] Graham and Poulter, *Proc. Roy. Soc.* (London), **B87**, 205 (1913).

[6] Folin and Svedberg, *J. Biol. Chem.*, **70**, 418 (1926).

[7] Larson, *ibid.*, **94**, 3 (1932).

[8] Wu, *ibid.*, **43**, 197 (1920).

[9] Hawk and Bergeim, "Physiological Chemistry," Blakiston, Philadelphia, Pa., 11th ed., 1937.