ethylene sulfonate, without apparent damage to three fundamental nuclear activities.

Summary.—Up to 75 per cent of the deoxyribonucleic acid of isolated thymocyte nuclei can be removed by incubation with pancreatic deoxyribonuclease. Nuclei so depleted of their DNA lose their capacity for ATP synthesis, for amino acid incorporation into protein, and for adenosine uptake into nuclear RNAs.

The addition of polyanions after DNAase treatment restores much of the biochemical activity of the nucleus. If polyanions are present at the time the DNA is removed, one can substitute for more than two-thirds of the DNA without *any* apparent loss of activity. The polyanions tested include DNAs, RNAs, and polyadenylic acid and non-nucleotides such as polyethylene sulfonate, heparin, and chondroitin sulfate. Added polycations, such as protamine or polylysine, do not restore function to DNAase-treated nuclei. Moreover, polylysine when added to "control" nuclei (whose DNA is still intact) greatly inhibits amino acid uptake into nuclear protein. The findings suggest a correlation between negative charge and the biochemical activity of the nucleus.

We are greatly indebted to the Research Laboratories of the Upjohn Company, Kalamazoo, Michigan, for the gift of the polyethylene sulfonates used in these experiments, and to Dr. Severo Ochoa for supplying enzymatically synthesized polyadenylic acid. It is a pleasure to acknowledge our thanks to Mr. Rudolf Meudt for his careful and expert technical assistance.

REFERENCES

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[1] V. G. Allfrey, A. E. Mirsky, and S. Osawa, *Nature*, **176**, 1042, 1955.

[2] V. G. Allfrey, A. E. Mirsky, and S. Osawa, *J. Gen. Physiol.*, **40**, 451, 1957.

[3] S. Osawa, V. G. Allfrey, and A. E. Mirsky, *J. Gen. Physiol.*, **40**, 491, 1957.

[4] V. G. Allfrey and A. E. Mirsky, *Proc. Natl. Acad. Sci.*, **43**, 589, 1957.

[5] V. G. Allfrey and A. E. Mirsky, *ibid.*, p. 821.

[6] R. B. Hurlbert, H. Schmitz, A. F. Brumm, and V. R. Potter, *J. Biol. Chem.*, **209**, 23, 1954.

[7] M. Grunberg-Manago and S. Ochoa, *J. Am. Chem. Soc.*, **77**, 3165, 1955.

[8] I. R. Lehman, M. J. Bessman, E. S. Simms, and A. Kornberg, *J. Biol. Chem.*, **233**, 163, 171, 1958.

[9] M. Sekiguchi and A. Sibatani, *Biochim. et Biophys. Acta*, **28**, 455, 1958.

[10] M. Friedkin and H. Wood, *J. Biol. Chem.*, **220**, 639, 1956.

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*A NEW WAY FOR THE SYNTHESIS OF 3-AMINO SUGARS**

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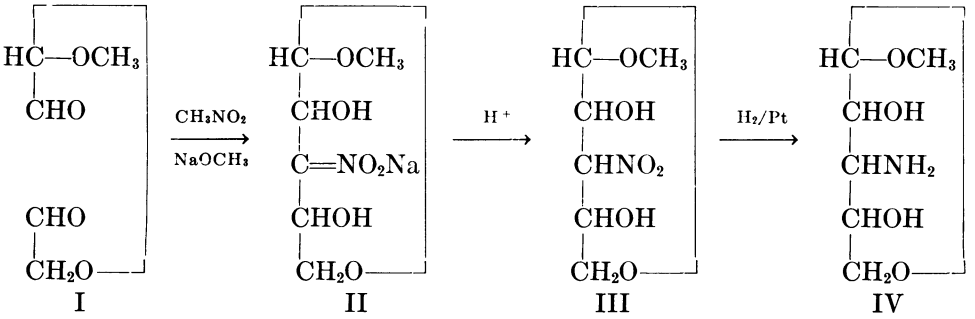
It was found ten years ago that 1,2-acetone-D-xylo-trihydroxyglutaric dialdehyde, a partly blocked dialdehyde of the pentose series, could be condensed with nitromethane and gave, in several steps, in good yield a mixture of nitro-deoxy-inositols.[1] This formation of a six-carbon ring made possible the chemical transformation of D-glucose into myo-inositol.[2]

Recently we observed that there exists a similar tendency preferentially to form six-membered rings when we condensed a dialdehyde (I) produced according to E. L. Jackson and C. S. Hudson[3] by the action of 2 moles of sodiumperiodate on methyl-β-L-arabinopyranoside with nitromethane,[4] the ring being formed by 5 carbon and 1 oxygen atoms:



In other words, in the pyranoside the original CHOH in position 3 was replaced by $CHNO_2$, thus producing 3-nitro-3-deoxy-glycosides, a new class of sugar derivatives. Apparently a twofold condensation of *one* mole of nitromethane with *both* aldehydo groups of the dialdehyde took place rather than condensations of nitromethane with each aldehydo function, even when nitromethane was present in excess.

The reaction yields the expected mixture of 3-nitro-pyranosides out of which one isomer could be isolated as a crystalline sodium salt (II) in a yield of about 40 per cent. Upon catalytic hydrogenation of the free nitro compound (III), we obtained a crystalline methyl-3-amino-3-deoxy-pentoside (IV) (m. p. 189°, $[\alpha]_D = +63.5°$, in water). B. R. Baker and R. E. Schaub[5] found for methyl-3-amino-3-deoxy-β-L-xylopyranoside m. p. 192–193 and $[\alpha]_D = +61.4$, in water. Furthermore, we could prepare a crystalline methyl-3-amino-3-deoxy-pentoside hydrochloride (m. p. 160°, $[\alpha]_D = +119°$ in water) and, by complete hydrolysis, the free amino sugar hydrochloride (crystals, $[\alpha]_D = +18°$ in water).

The analogous series of reactions was applied to a representative of the hexoses, namely, methyl-α-D-glucoside. We obtained in very good yield the condensation product in the form of its sodium salt. The free methyl-3-nitro-3-deoxy-hexopyranoside gave, upon hydrogenation, a corresponding amino derivative which was characterized as its crystalline hydrochloride (decomp. 203°–208°. $[\alpha]_D = +66°$, in water). Configurational assignment was not yet possible because of the lack of compounds of reference.

The experimental details will be published elsewhere.

The wide applicability of the newly discovered pathway of synthesis of 3-amino-sugar derivatives is obvious. Our investigation was prompted by the recently developed interest in 3-amino-sugars, especially in the chemistry of antibiotics. Thus 3-amino-3-deoxy-D-ribose is known to be the sugar moiety of puromycin, and various hexoses and deoxyhexoses carrying a dimethylamino group on carbon atom 3 have been isolated from other antibiotics. Whereas an enormous amount of work has been done on the chemistry of the 2-amino-2-deoxy sugars, relatively little is known of their 3-amino analogues, apart from some older investigations and the recent extensive studies of B. R. Baker and his school.[6]

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[1] J. M. Grosheintz and H. O. L. Fischer, *J. Am. Chem. Soc.*, **70**, 1479, 1948.

[2] Th. Posternak, *Helv. Chim. Acta*, **33**, 1597, 1950.

[3] E. L. Jackson and C. S. Hudson, *J. Am. Chem. Soc.*, **59**, 994, 1937.

[4] The same dialdehyde (I) would be, of course, obtained by periodate cleavage of methyl-α-D-xylopyranoside.

[5] B. R. Baker and R. E. Schaub, *J. Org. Chem.*, **19**, 646, 1954.

[6] For literature see P. W. Kent and M. W. Whitehouse, *Biochemistry of the Amino Sugars* (London, 1955); H. H. Baer, "Chemie der Aminozucker," *Fortschr. chem. Forsch.*, **3**, 822, 1958.

THE ENZYMATIC SYNTHESIS OF FATTY ACIDS BY ALDOL CONDENSATION

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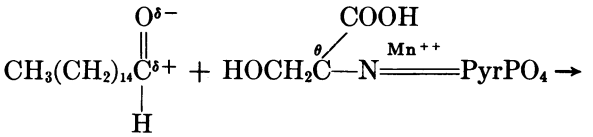
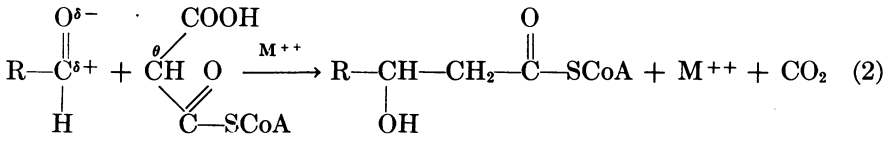
INTRODUCTION

The mechanism of the enzymatic synthesis of sphingosine has recently been established as an aldol condensation of the Knoevenagel type.[1, 2] Such a reaction mechanism had not been previously detected in biological systems. The formation of dihydrosphingosine occurs by a condensation between palmitic aldehyde and the activated methylene group of serine in the presence of pyridoxal phosphate ($PyrPO_4$) and Mn^{++} ions (Reaction 1):



$$CH_3(CH_2)_{14}CH(OH)CH(NH_2)CH_2OH + PyrPO_4 + Mn^{++} + CO_2 \quad (1)$$

The observation that acetaldehyde is a better precursor of fatty acids than acetate[3] and the finding that the addition of malonate caused a marked enhancement of fatty acid synthesis[4] suggested that the formation of fatty acids might also occur by condensation of aliphatic aldehydes with the activated methylene group of malonyl coenzyme A (malonyl CoA) (Reaction 2):



The synthesis of fatty acids has recently been shown to be dependent upon supplemental adenosine triphosphate (ATP), Mn^{++}, and HCO_3^- when acetyl