developing a loose black scale; the same alloy previously heated in a hydrogen atmosphere containing water vapour at a partial pressure 0.1 mm. (which still permits sufficient oxidation to develop a film of copper-free alumina), remained quite undarkened and gained only 4 mgm./sq. dm. when heated under the same conditions. Similarly, silver containing 1 per cent aluminium was found to tarnish rapidly when exposed to a polluted atmosphere, whereas the same alloy pre-heated in damp hydrogen at 400° C. so as to produce an invisible film of silver-free alumina, suffered no change in appearance within thirty times this period; pre-heating in air at atmospheric pressure did not reduce the tendency to tarnishing.

Several other examples could be given and full results will be published shortly. It is hoped that this principle of selective oxidation will play an important part in overcoming the deterioration of metals.

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¹ Miyake, S., *Sci. Papers Inst. Phys. Chem. Res. (Tokyo)*, **31**, 161 (1937).

² Sloman, H. A., *J. Inst. Met.*, **49**, 365 (1932).

³ Raub, E., *Mitt. Forschungs Edelmetalle*, **8**, 77 (1934).

⁴ Hoar, T. P., and Price, L. E., *Trans. Faraday Soc.*, 1938, Symposium on "Chemical Reactions Involving Solids".

⁵ Wagner, C., *Z. phys. Chem.*, **B**, **21**, 25 (1933).

⁶ Koch, E., and Wagner, C., *Z. phys. Chem.*, **B**, **38**, 295 (1937).

⁷ Jander, W., and Stamm, W., *Z. anorg. Chem.*, **199**, 169 (1931).

Effect of Succinic Acid on the Respiration of Normal Human Muscle and Various Myopathies

SUCCINIC acid has long been known to be oxidized rapidly by muscle and many other tissues. Experiments of Szent-Györgyi and co-workers¹ suggested that succinic acid and certain other dicarboxylic acids catalyse the aerobic respiration of muscle tissue. Conclusive proof for this catalysis in muscle tissue was given by Stare and Baumann², and its application to liver and kidney tissue was shown by Stare³.

In current studies on the respiration of human muscle tissue, we have observed that in muscle taken from patients with myasthenia gravis and progressive muscular dystrophy, succinic acid fails to catalyse the aerobic respiration and is itself oxidized only to a very slight extent. Malonate was found to inhibit the respiration. With normal human muscle tissue we observed the expected catalytic result upon addition of succinic acid as well as malonate inhibition.

The experiments were done in Warburg manometers at a temperature of 38° C. and in a Ringer phosphate-glucose buffer at pH 7.4. The tissues were obtained by muscle biopsy and immediately ground in an ice-cold Latapie mincer. Succinate and malonate were added as the sodium salts in concentrations of 0.003 and 0.03 molar. The following table shows typical experiments:

Muscle	Condition	Q _{O₂}	Increase of Q _{O₂} with succinate		Decrease of Q _{O₂} with malonate
			(0.003 M.)	(0.03 M.)	
Gastrocnemius	Myasthenic Prog. muscular dystrophy	3.9	+ 3 per cent	+ 8 per cent	- 47 per cent
Gluteal		3.7	+ 5 " "	+ 5 " "	- 38 " "
Abdominal rectus	Normal	3.4	+ 27 " "	+ 50 " "	- 60 " "

The percentage increase in U_{O₂} values with succinate calculated at 90 and 20 minutes were even more striking than the Q_{O₂} values presented.

These results are of particular interest since they suggest that certain disturbances in the intermediary metabolism of normal muscle may be associated with these myopathies. These experiments are being continued and will be reported in detail in a forthcoming communication.

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¹ Szent-Györgyi, A., and co-workers, *Z. physiol. Chem.*, **236**, 1 (1935).

² Stare, F. J., and Baumann, C. A., *Proc. Roy. Soc., B*, **121**, 338 (1936).

³ Stare, F. J., *Biochem. J.*, **30**, 2257 (1936).

Vitamin B₁ and Cocarboxylase

THE appearance of a paper by Lipschitz *et al.*¹ in which the authors consider that tissue extracts induce a synthesis of cocarboxylase from vitamin B₁ and phosphate by alkaline washed yeast prompts the publication of the facts below; they form part of an investigation on the phosphorylation of the vitamin suggested to me by Prof. R. A. Peters.

Lohmann and Schuster² found cocarboxylase to be vitamin B₁ pyrophosphate, but the vitamin itself was inactive as cocarboxylase. While confirming the latter fact, I find that the action of pure cocarboxylase is strongly stimulated by the addition of synthetic vitamin B₁. The graph which follows shows the activating effect of the vitamin on 1 γ cocarboxylase* using alkaline washed yeast and pyruvic acid. The pyrimidine group of the vitamin seems to be the one responsible for this activation. Pyrimidine I* has

about 1/10, pyrimidine II 1/30 the activity of the vitamin. Pyrimidine III, without the NH₂ group, is inactive up to 90 γ. This may be of significance in view of Langenbeck's findings³ on artificial carboxylases. Thiazole (up to 90 γ) is inactive, as also is vicine, cytidylic acid (commercial specimen) and nicotinamide (up to 100 γ). The stimulation by the vitamin of the action of boiled tissue extracts is due to the presence of cocarboxylase in the latter.

The activation of the carboxylase reaction by vitamin B₁ is being explored for the estimation of both cocarboxylase and free vitamin B₁ in