has been shown;[7] and (4) epinephrine in a concentration of $1:10^9$ injected intradermally in the cat's tail will produce a fleeting piloerection similar to that produced by nicotine, acetylcholine, lumbar sympathetic stimulation or physiological goose flesh stimuli.

Summary. Experiments are cited which indicate that the local pilomotor action following intradermal acetylcholine occurs by virtue of its nicotine-like action, and that this drug as well as nicotine and other drugs possessing nicotine-like action exert this influence through an axon reflex the receptor end of which has several properties characteristic of autonomic ganglia and the effector end of which is evidently adrenergic.

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Nature of a Sweat Response to Drugs with Nicotine-like Action.

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In a preliminary report on the nature of a local pilomotor response to acetylcholine injected intradermally[1] experiments have been cited which indicate that this pilomotor response occurs by virtue of the nicotine-like action of acetylcholine. The same effect can be obtained by nicotine and by alpha-lobeline. Drugs with nicotine-like effect act through an axon reflex in terminal branches of postganglionic sympathetic axons. The receptor end of the axon reflex behaves like an autonomic ganglion, whereas the motor end is evidently adrenergic.

An analogous phenomenon can be shown in the domain of cholinergic nerve endings. If 0.1 cc nicotine 1:100,000, alpha-lobeline 1:1,000,000, or acetylcholine 1:40,000 is injected intradermally in man, drops of sweat appear around the injection wheal in an area about 4 cm in diameter. The sweat secretion can be visualized easily by Minor's iodine-starch method.[2] At high room temperature and humidity and in persons sweating easily the sweat drops can be seen without an indicator.

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[7] Rosenblueth, A., and Cannon, W. B., *Am. J. Physiol.*, 1932, **99**, 398.

[1] Coon, J. M., and Rothman, S., PROC. SOC. EXP. BIOL. AND MED., 1939, **42**, 229.

[2] Minor, V., *Deutsche Z. f. Nervenheilk.*, 1927, **101**, 302.

The mechanism of this response differs from the direct action of acetylcholine on sweat glands. This is shown by the following facts: (1) intradermal acetylcholine in concentrations up to 10% causes local sweating whereas other drugs with nicotine-like action are effective only within a dilute range of concentration; (2) the sweat response to nicotine can be paralyzed by 1:200,000 dilutions of local anesthetics mixed with the nicotine, whereas the direct effect of acetylcholine is not impaired by them; (3) the local effect of acetylcholine originates in the injection wheal and spreads slowly into the neighborhood following the diffusion of the drug whereas the sweat secretion caused by nicotine appears as quickly in the outlying areas as on the wheal itself, corresponding to the effect of a nervous impulse.

Acetylcholine, then, apparently elicits sweat secretion in 2 different ways: (1) by direct effect on sweat glands and (2) by acting on nerve endings through its nicotine-like action. In high dilutions acetylcholine elicits sweating in the outlying areas, similarly to nicotine. This nicotine-like action of acetylcholine is proved by the fact that injections of acetylcholine in high concentrations inhibit the otherwise stimulating effect of a subsequent nicotine injection at the same point. This finding explains the observations on anhidrotic effects of high acetylcholine doses.[3, 4, 5] High nicotine concentrations also have a paralyzing effect.

Pilocarpine behaves similarly to acetylcholine in its direct action. If applied intradermally pilocarpine elicits sweating over the injection wheal, independent of concentration, not influenced by foregoing injection of highly concentrated nicotine and not influenced by local anesthetics.

In man, if 1 mg of atropine is administered the sweating response to nicotine is abolished or considerably weakened. The effect of atropine in this experiment corresponds to the paralyzing effect of ergotoxine on the pilomotor mechanism (1) whereas the direct effect of acetylcholine and pilocarpine on sweat glands corresponds to the direct effect of epinephrine on pilomotor muscles.

Blockade of the lateral cutaneous antibrachial nerve by procaine does not impair the sweat response to nicotine in the remote anesthetic area. However, in areas in which the corresponding nerve has degenerated, the sweat fails to appear after nicotine.

These findings furnish strong evidence for the axon reflex nature of the sweat response elicited. The receptor end of the axon reflex

[3] Villaret, M., and Even, R., *Presse med.*, 1928, **2**, 1561.

[4] Ackermann, A., *Dermatologica*, 1939, **79**, 151.

[5] Hashimoto, extracted by (4), p. 156.

behaves like an autonomic ganglion whereas the effector end is cholinergic. From these experiments it cannot be determined whether receptor and effector ends are different anatomically and physiologically or all the ramifications of the postganglionic cholinergic sweat and adrenergic pilomotor fibers serve as receptors as well as effector ends.

The question arises as to whether this axon reflex mechanism plays a rôle in physiological responses to external cutaneous pilomotor and sweat stimuli. The primary confinement of these cutaneous responses to the area surrounding the point of stimulation, and their secondary unilateral and bilateral expansion seem to indicate that primary axon reflexes are followed by long spinal reflexes.

Summary. Localized sweat secretion can be elicited by intradermal injection of drugs with nicotine-like action. This effect is accomplished through a peripheral axon reflex mechanism which is easily differentiated experimentally from the direct muscarine action of acetylcholine on the sweat glands.

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Reduction of Dehydroascorbic Acid in the Stomach and Small Intestine.*

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In view of the fact that a portion of the Vitamin C intake of animals and man may be in the form of dehydroascorbic acid,[1-4] it is of interest to know whether the unstable reversibly oxidized form can be utilized efficiently, and whether there is a significant degree of reduction to ascorbic acid in the intestinal tract. It is clearly recognized that dehydroascorbic acid is effective as an antiscorbutic

* Contribution No. 390 from the Department of Chemistry, University of Pittsburgh. The authors are indebted to the Buhl Foundation for a research grant that has made the present investigation possible.

1 Bessey, O. A., *J. Biol. Chem.*, 1938, **126**, 771.

2 Reedman, E. J., and McHenry, E. W., *Biochem. J.*, 1938, **32**, 85.

3 Tressler, D. K., *et al.*, *Food Research*, 1938, **3**, 133, 311, 403, 409.

4 Fujita, A., and Ebihara, T., *Biochem. Z.*, 1937, **290**, 201; Fujita, A., and Sakamoto, T., *ibid.*, 1938, **297**, 10.