ESTERASOPENIC AND ESTERASOPLENIC PERIPHERAL NERVE TERMINATIONS

DALE[1] simplified our thinking on function in the peripheral nervous system when he classified the peripheral nerve fibers in two groups, cholinergic and adrenergic. He pointed out that all the nerve fibers leaving the central nervous system are cholinergic, as are also the parasympathetic postganglionics and a few of the sympathetic postganglionics. Most of the sympathetic postganglionics, however, are adrenergic. Dale[2] had pointed out earlier that acetylcholine has two types of actions, the so-called "muscarinic" and "nicotinic" actions in which it mimics the corresponding drugs. In its "muscarinic" action, acetylcholine reproduces the peripheral effects of parasympathetic nerve stimulation, effects produced with low concentrations of acetylcholine and readily abolished by atropine. When the "muscarinic" effects have been abolished by atropine, then the "nicotinic" action becomes apparent as an intense stimulation of all autonomic ganglion cells. Skeletal muscle shows the "nicotinic" effects of acetylcholine even in those rare instances in which it receives a parasympathetic postganglionic innervation. Larger doses of acetylcholine are required to evoke the "nicotinic" effects and these effects appeared to be unaffected by atropine.

It is possible that the differences in acetylcholine concentrations required to elicit the "muscarinic" and "nicotinic" effects may be due in part to differences in cholinesterase concentrations at the respective terminations. High cholinesterase concentrations have been demonstrated by eserine potentiation of acetylcholine at autonomic preganglionic and voluntary motor termination where the "nicotinic" effects of acetylcholine are seen and where atropine is relatively ineffective. Eserine potentiations of the "muscarinic" effects of acetylcholine also have been frequently reported, but in these experiments no attempt was made to differentiate between potentiation due to cholinesterase generally distributed through the tissues and that specifically concentrated at the nerve terminations. This factor was controlled in experiments on the sphincter pupillae of small salamanders[3] and turtles.[4] The eyes were excised and all possible extraneous tissues removed, leaving the iris diaphragm, a supporting rim of sclera and the ciliary body. There was very little tissue covering the sphincter muscle in the thin free margin of the irises of these small eyes. The sphincters of both eyes receive a parasympathetic postganglionic innervation.

The sphincter pupillae of the turtle, which is striated muscle, has an acetylcholine threshold of one in one million which is potentiated a hundredfold by eserine, indicating relatively high concentrations of cholinesterase at its nerve terminations. Relatively high concentrations of atropine are required to reduce the pupillary constriction to acetylcholine. These findings are characteristic of the "nicotinic" action of acetylcholine. The sphincter pupillae of the salamander, which is composed of smooth muscle, has an acetylcholine threshold of about one part in one billion. Eserine does not potentiate the pupillary constriction resulting from the application of acetylcholine, so there is no demonstrable cholinesterase at its nerve terminations. Atropine in relatively low concentrations reduces or completely abolishes acetylcholine constriction. The threshold to acetylcholine and the great effectiveness of atropine are characteristic of the "muscarinic" action of acetylcholine.

It is suggested that there are two types of peripheral cholinergic nerve fibers, those at whose terminations there are relatively high concentrations of cholinesterase and those at which cholinesterase is lacking or present in only non-demonstrable concentrations. These might be termed respectively esterasoplenic and esterasopenic terminations. The generality of this classification can be definitely established only by additional work on other cholinergic postganglionic terminations. One should not overlook the possibility that there may be in some organs, which show both acetylcholine effects, both types of cholinergic terminations.

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1 H. H. Dale, *Jour. Physiol.*, 80: 10–11, 1933.
2 *Idem, Jour. Pharmacol. and Exp. Therap.*, 6: 147–190, 1914.
3 P. B. Armstrong, *Jour. Cell. and Comp. Physiol.*, 20: 47–53, 1942.
4 *Idem, Jour. Cell. and Comp. Physiol.*, 22: 1–19, 1943.

ON DIRECT VISION CHARACTERISTICS OF SPOTS PRODUCING TERRESTRIAL MAGNETIC PHENOMENA

IT is well known that the transit of a large group of sunspots may be followed by aurorae and disturbances in the earth's magnetic field; but this is not invariably the rule. Occasionally smaller groups may cause more violent disturbances than larger ones, and sometimes no effect whatever is noticed. Therefore not all spots will produce terrestrial electromagnetic effects; but, unless one knows what to look for, direct visual examination will reveal no essential difference between those spots which do and those which do not. However, the writer has worked out a method which appears to be very satisfactory.

In 1850 Lamont at Munich, with insufficient data, discovered that the mean variation of the diurnal magnetic oscillation showed a period of close to 10.33 years. This was followed in 1851 by Schwabe's announcement that the sunspots are periodic.