# ANALYSIS OF DOPAMINE SPECIFIC, EXCITATORY AND INHIBITORY ACTIONS ON NEURONS OF THE SNAIL

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DOPAMINE fulfills a neurotransmitter function in several areas of the mammalian brain as well as in nervous system of several invertebrates.

A number of psychopharmacological agents induces behavioural changes in animals and man by interfering with dopaminergic transmission processes. Amphetamine and apomorphine produce stereotyped behaviour by indirect and direct activation of dopamine receptors in the neostriatum while neuroleptic agents block dopamine receptors and thereby abolish the behavioural effects of apomorphine, amphetamine and dopamine (VAN ROSSUM, 1970).

Dopamine when applied directly onto neurons of the neostriatum causes inhibition of spontaneous activity of many sensitive neurons but excitation of others (BLOOM *et al.*, 1965; YORK, 1970).

Most dopamine sensitive neurons of the brain of the snail *Helix aspersa* show inhibition of activity after application of dopamine, although there are neurons that are excited by dopamine. The neurons inhibited by dopamine have been analysed in detail (WOODRUFF, 1971). It appeared, however, that the notorious dopamine-mimetic apomorphine does not cause dopamine like inhibition but rather antagonised dopamine induced inhibition (see Fig. 1C). Furthermore neuroleptics, like haloperidol, did not antagonise dopamine in inhibitory dopamine sensitive neurons (see Fig. 1A). On the other hand ergometrine appeared to act as a selective antagonist in these neurons (WOODRUFF, 1971).

From behavioural studies evidence is accumulating that stereotyped behaviour is mediated by activation of dopamine receptors on neurons that are excited by dopamine rather than inhibited (COOLS, 1973).

We therefore analysed in the brain of the snail those dopamine sensitive neurons that are excited by dopamine. (See Figs. 1D and E). These neurons which are excited by dopamine also show excitation following application of apomorphine. Further the neuroleptics as for instance haloperidol are blocking agents of dopamine induced excitation. In most of such "excitatory" dopamine sensitive neurons, haloperidol by itself induced inhibition but in others it was inactive or even might produce excitation.

It is concluded that the excitatory dopamine neurons of the snail serve as a model for dopamine sensitive neurons of the mammalian brain which are involved in behavioural effects elicited by apomorphine and blocked by neuroleptics.

## REFERENCES

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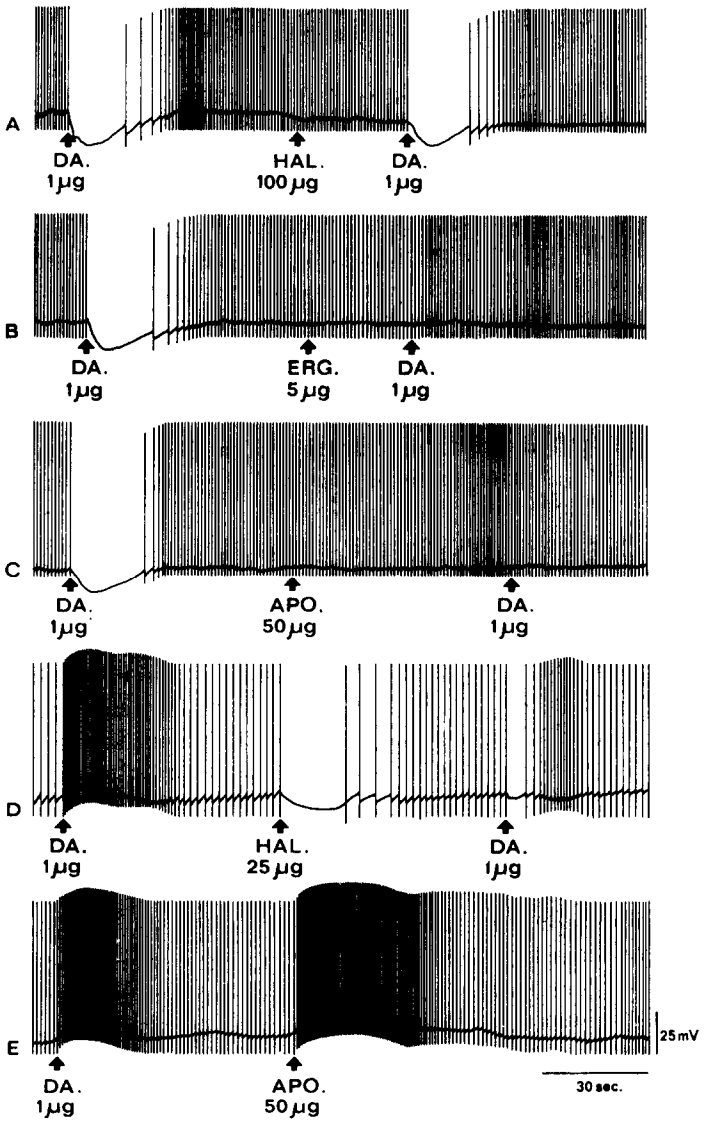


FIG. 1.—Registration of electrical activity of "inhibitory" (A–C) and "excitatory" (D, E) dopamine sensitive neurons. (A) Dopamine is inhibitory in sensitive neurons of the visceral and pleural ganglion cells as shown by hyperpolarisation and a diminution of action potential frequency. The neuroleptic haloperidol is ineffective in antagonizing this inhibition. (B) Ergometrine blocks the inhibitory action of dopamine. (C) Apomorphine does not mimic dopamine on inhibitory cells but rather acts as an antagonist. (D) Dopamine is excitatory on some neurons in the visceral ganglion and haloperidol antagonises this excitation. (E) Apomorphine mimics the dopamine response on neurons excited by dopamine.