rons it caused inhibition[11]. But recently, **Dafny** and **Gilman**[12] reported enhancement of acoustic evoked responses in the caudate nucleus following administration of L-DOPA 100 mg/kg in rats. **Sabelli** et al.[13] reported that L-DOPA doses of 20 and 50 mg/kg decreased the amplitude of the fast positive components of the photically evoked potentials in rabbits, but 50 mg/kg of L-DOPA pretreated 24 h before with tetraethylthiuram disulfide (dopamine-β-hydroxylase inhibitor) increased the amplitude.

In this study, we observed reduction in amplitude of visual evoked responses after administration of 10 and 20 mg/kg of L-DOPA, but enhancement soon after the injection of 40 and 80 mg/kg. This conversion seems very interesting. **Wachtel** and **Kandel**[14] demonstrated a dual chemical synapse of *Aplysia:* an excitatory receptor with a low threshold to acetylcholine and an inhibitory receptor with a higher threshold to acetylcholine. **Corrodi** et al.[15] reported interaction between cholinergic and catecholaminergic neurons: amine turnover is slightly reduced in the telencephalic dopaminergic terminals and increased in the noradrenergic terminals by the anticholinergic drugs. Thus, the synaptic transmitter can, on the one hand, produce a dual effect, and on the other hand, may interact with other transmitters.

Differences in effect of L-DOPA in recording sites are also worth attention. Namely, the most prominent effect was seen in the primary visual area, moderate one in the association area, and slight one in the cerebellar vermis. This may depend on different pathways from the retina to the recording site and on the chemical transmitters between them.

In any case, the evidence obtained in this study seems to suggest complicated brain mechanisms, and further studies are necessary to explain them.

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Central Course of Photic Input in the Ventral Nerve Cord of Scorpion (*Heterometrus fulvipes*)

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Summary. The course of the photic input from the metasoma in the ventral nerve cord of scorpion was studied. The input was found to influence the activity in a large number of neurons in the nerve cord. The phenomenon of contralateral stimulation of units at various levels of the nerve cord has heen demonstrated.

Simple neural photoreceptors have been reported in a wide variety of animals, and there has been a growing interest in the comparative physiology of these photoreceptor systems. During our studies on the central nervous system of the scorpion *Heterometrus fulvipes*, it was observed that the abdominal ganglia in the metasoma and the telsonic nerves of the animal are directly sensitive to light. The various aspects of the physiology of these metasomatic photoreceptors (MPR) in scorpion are being studied in our laboratory, and some of our findings have been reported earlier[2,3]. The present study was an attempt to follow the central course of the photic input from the MPR and to examine the phenomenon of contralateral stimulation of units in the ventral nerve cord of scorpion.

Methods. The tergal plates of the metasoma and mesosoma were removed and the ventral nerve cord was exposed. The electrical activity was recorded in air from the ventral nerve cord connectives using platinum hook electrodes. A narrow beam of light from a tungsten filament microscope lamp fitted with a heat-filter was used for photic stimulation. The conventional electronic set up used for the study consisted of a Tektronix 502A dual beam Oscilloscope, Grass P9 preamplifiers and Grass AM3 audiomonitor. A Grass C4 kymograph camera was used for photographing the electrical activity.

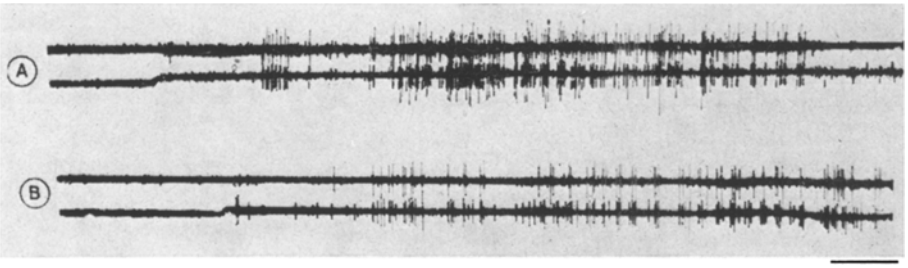

Fig. 1. A) Responses from the left (lower trace) and the right (upper trace) 2–3 connectives to photic stimulation of the fifth abdominal ganglion.
B) Responses from the left (lower trace) and the right (upper trace) 1–2 connectives to photic stimulation of the sixth ganglion. The activity was recorded from the whole connectives. Note the phase relationship between the activity in the 2 halves of the cord in both A and B. Activity is superimposed on the light signal in the lower traces of A and B in this figure and in Figure 3. Calibration: 0.5 sec.

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Results. A large number of neurons in the ventral nerve cord were found to be excited on photic stimulation of MPR. This was especially evident when the activity was recorded from the whole connectives (Figure 1). When the responses to illumination of the MPR were simultaneously recorded from the 2 halves of the nerve cord at a given level, it was evident that the activities in the 2 halves very much correspond with each other and there was considerable phase relationship (Figure 1). This indicated that there may be parallel pathways which are excited simultaneously.

This similarity in the responses from the 2 halves of the nerve cord stimulated, testing the possibility of contralateral stimulation of units. This possibility of stimulation of units in one connective by units in the contralateral connective was studied by simultaneously recording the responses from the ascending units in contralateral connectives at different levels of the nerve cord (Figure 2A). Thus activities from the left 3–4 connective (upper trace) and the right 4–5 connective (lower trace) were recorded after severing the left 4–5 connective and the anterior end of the left 3–4 connective (Figure 3A). About 2 to 3 units responded in the left 3–4 connective to photic stimulation of the 6th abdominal ganglion, showing that these units receive the excitation from the posterior contralateral (right) 4–5 connective. Similarly, units in the right 2–3 connective (upper trace) responded to photic stimulation of the 6th ganglion after severing the right 3–4 connnective and the anterior end of the right 2–3 connective, showing that they receive photic input from the posterior left 3–4 connective (Figure 3B).

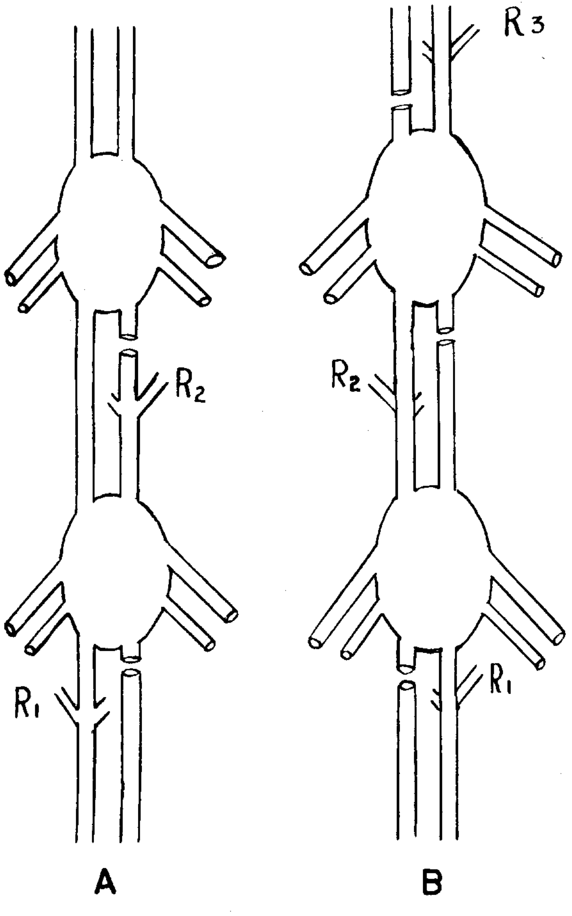

Fig. 2. Arrangement of the recording electrodes (R1 to R3) to study the contralateral stimulation of units in the ventral nerve cord at a given level (A) and simultaneously at different levels (B).

The number of units in a connective receiving excitation from the posterior contralateral connective was counted by isolating single units by teasing the connectives and recording the responses from individual units after similarly severing the posterior ipsilateral connective and the anterior end of the connective from which the responses are being recorded. It was evident from such studies that the input from the MPR crosses over from one side of the ventral nerve cord to the other side at various levels (Table). The number of such units receiving excitation from the posterior contralateral connectives appeared to be greater between the suboesophageal ganglion and the second ganglion.

With a slightly different arrangement of the recording electrodes (Figure 2B), the input from the MPR was also observed to cross over sequentially more than once in the successive ganglia, in that the ascending units which receive excitation from the posterior contralateral units in turn excited units in the anterior contralateral connective. This suggests that there is extensive ramification of units in the ventral nerve cord and divergence of photic input from MPR.

Discussion. The present investigation demonstrates the presence of a ladder-like nerve cord in scorpion where there are chances of wide circulation of impulses. Thus the ascending units in a connective were found to excite the contralateral ascending units in the cord anteriorly, in addition to exciting the ipsilateral units. These contralateral units in turn were found to excite other contralateral units as well as ipsilateral units higher in the nerve cord. Thus there is extensive divergence of the photic input from the metasoma, involving the influence of activity in a large number of central units.

The crossing over of the photic input from one side of the ventral nerve cord to the other side may be due to two reasons: there may be synaptic excitation of the contralateral units or it may be due to the crossing over of fibres themselves across the ganglia. Thus, the units in the left 3–4 connective and the right 2–3 connective (Figure 3) may be either synaptically activated in the 4th and 3rd ganglia respectively, or there may be units which

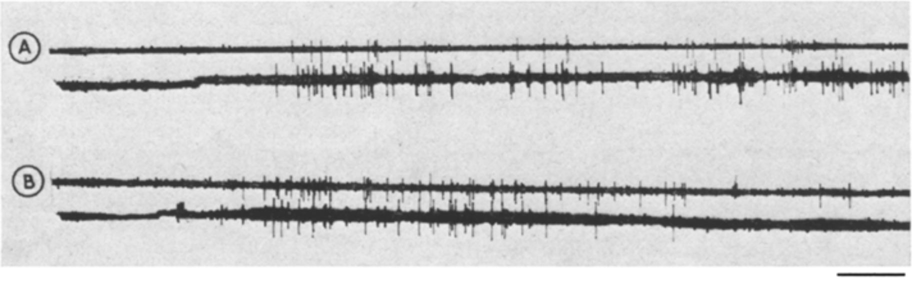

Fig. 3. A) Responses from units in the left 3–4 connective (upper trace) and the right 4–5 connective (lower trace).
B) Responses from units in the right 2–3 connective (upper trace) and the left 3–4 connective (lower trace). The units in the upper traces of the two records receive excitation from posterior contralateral connectives. The 6th abdominal ganglion was photically stimulated. Calibration: 0.5 sec.

Number of units receiving excitation from the posterior contralateral connectives at different levels of the ventral nerve cord on photic stimulation of the 6th abdominal ganglion.

Direction of crossing over of the photic input		No. of preparations examined	Mean No. of units (Values corrected to the nearest whole number)	Maximum No. of units observed in a preparation
From	To			
Connectives				
Left 5–4	Right 4–3	14	6	8
Left 4–3	Right 3–2	14	5	7
Left 3–2	Right 2–1	18	3	6
Left 2–1	Right 1–SOG[a]	16	2	4
Right 5–4	Left 4–3	14	5	8
Right 4–3	Left 3–2	14	6	8
Right 3–2	Left 2–1	16	3	6
Right 2–1	Left 1-SOG[a]	14	4	6
Left 5–4 to Right 4–3 to Left 3–2		12	2	5
Right 5–4 to Left 4–3 to Right 3–2		12	3	4

[a] Suboesophageal ganglion.

cross over from one side of the nerve cord to the other. Such a distribution of fibres, whereby they travel across a ganglion and enter the next contralateral connective, has been described in the nerve cord of scorpion[4]. But, in the present examples, the responding units in the two contralateral connectives did not resemble each other in spike characteristics, and there was no strict correspondance between the activity in the two connectives. This suggested that the units in the anterior contralateral connectives are synaptically activated in the intermediate ganglia even though the alternate possibility in other cases is not altogether ruled out. Similar excitation of contralateral units by tactile afferents and divergence of tactile input has been demonstrated earlier in scorpion[5].

The decrease in the frequency of contralateral excitation anteriorly indicates that there may be dropping off of the sensory input from the metasoma. It may also mean that there is greater convergence of units anteriorly. This is further supported by the anatomical studies, wherein the number of fibres in the connectives were found to decrease in the postero-anterior direction in the ventral nerve cord of scorpion[4].

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Alternative Methods of Animal Sacrifice: The Effect on Intestinal Function in vitro

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26 September 1975.

Summary. The total fluid uptake of everted sacs of rat jejunum was compared in animals killed by stunning and decapitation, or anaesthetised with ether. Fluid transport was significantly higher in the tissue prepared from stunned and decapitated animals. It is suggested that etherization may have adverse effects on the physiological viability of subsequently isolated tissues.

Despite the widespread use of in vitro intestinal preparations there appears as yet to be little standardization of technique. The short study described herein was undertaken in order to decide between two alternative methods of animal sacrifice, etherization, and stunning and decapitation, prior to the preparation of everted sacs. Fluid absorption was chosen as a convenient index of structural viability as it is thought to occur as a corollary of active solute transport at the mucosal surface[2].

Methods. Male Wistar rats of 180–210 g body weight were allowed water ad libitum but were deprived of food (Heygates 41B) for about 18 h overnight before use. Animals were sacrificed by 2 methods.

1. *Etherization.* The rat was placed on the metal grid of a glass vacuum-desiccator, the lower section of which was filled with a quantity of cotton wool soaked in diethyl ether. As soon as the animal lost consciousness it was removed from the killing jar, the abdomen was opened with a mid-line incision and the entire small intestine was removed by severing it at the duodenal-jejunal flexure, and at the ileo-caecal junction. The animal was then killed by decapitation.

2. *Stunning and decapitation.* The rat was placed gently on the surface of a laboratory stool with a minimum of disturbance. After a few sec the animals was swung suddenly by the tail and stunned with a single blow against

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