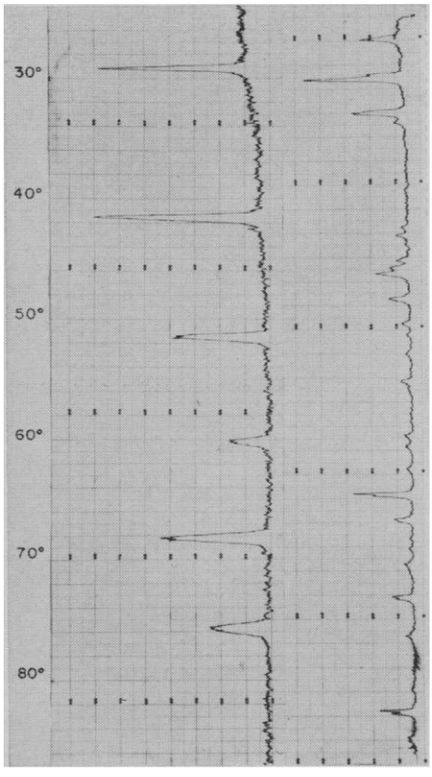

Fig. 1. X-ray diffraction patterns for allotropes of InTe; ordinate, degrees (2θ); abscissa, relative intensity. Left trace: InTe(II), cubic form; right trace: InTe(I), tetragonal form.

taken at 25°C, Fig. 1, exhibits no diffraction lines corresponding to In, Te, or InTe(I) thus indicating that the conversion was essentially complete.

The cubic structure with six nearest neighbors causes an insufficiency in the valence electrons for covalent bonding, which we believe leads to a condition of resonance equivalent to the metallic state (*4*).

The physical properties are interesting. Whereas the InSb metal is very hard, nearly as hard as steel, the InTe metal is very soft and friable. It is readily scratched by glass. Our preparations have consisted of crystals of mean dimensions of 2000 Å as judged from the width of the x-ray lines.

The most remarkable of the obvious physical properties is the beautiful light blue color which the new metal shows on all its crystalline faces. This light blue metallic luster changes to a darker blue when the metal is cooled to −197°C.

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31 July 1963

Superconductivity of Metallic Indium Telluride

Abstract. *Metallic indium telluride is a superconductor with a transition temperature of 2.18°K. The critical magnetic field is about 800 gauss.*

Superconductivity in metallic InTe prepared and stabilized at atmospheric pressure in the way described by Darnell, Libby, and Yencha (*1*) has been observed by the same method as previously reported for the measurement of metallic InSb (*2*). In order to obtain a good filling factor for the measurement coil, seven specimens about 5 mm in diameter with lengths ranging from 1 mm to 12 mm were measured simultaneously. The total length was about 25 mm. The specimens were presumably polycrystalline.

The zero-field transition temperature T_0 appeared to be at 2.18°K and showed, contrary to InSb, a relatively sharp transition width of about 0.01°K. The sharpness of the transition might indicate that the specimens were not highly strained. Measurements in magnetic fields showed, as might be expected from the non-ideal geometry, that the intermediate state extended over a fairly wide range.

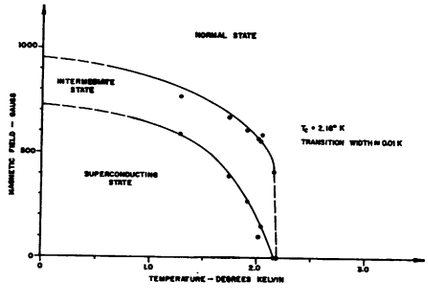

Fig. 1. The critical magnetic field as a function of temperature for InTe (II) (metallic indium tellurium).

The results are shown in Fig. 1. The lower curve represents the magnetic field at which normal conductivity started to appear at a given temperature. The upper curve represents the field at which the transition to the normal state was completed for the same temperature. Extrapolation of the curves to zero degrees would indicate a critical field $H_c(0)$ of about 800 gauss.

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31 July 1963

Cholinergic Substance in the Caudal Neurosecretory Storage Organ of Fish

Abstract. *Cholinergic substance exists in homogenates of caudal neurosecretory storage organs of fish. The caudal organs of fresh-water fish contain about 10 times the amount found in caudal organs of marine fish. The substance in the caudal organ of the carp is more than 100 times as concentrated as that in the brain.*

Several investigators have suggested that acetylcholine may play an important role in the mechanism releasing neurohormones from neurosecretory storage organs, such as the neurohypophysis, into capillaries (*1*, *2*). This hypothesis is supported by the discoveries that the neurosecretory axon endings in the neurosecretory storage organs contain synaptic vesicles (*3*) which are thought to be the carriers of acetylcholine (*4*); that the synaptic vesicles change in size or number when neurohormones are released from the neurohypophysis into capillaries (*2*); and that acetylcholinesterase is present in the neurohypophysis of the cat (*1*). Until now, no study to detect acetylcholine or cholinergic substances in

neurosecretory storage organs has been undertaken.

We examined the caudal neurosecretory storage organ (*5*) of fish for cholinergic substances by bioassay on isolated hearts of the bivalve, *Schizothaerus nuttalli*. This method was originally described by Welsh, and it is specific for choline esters and has high sensitivity for acetylcholine (*6*, *7*). Our results are shown in Table 1.

The average total amount of cholinergic substance obtained from five carp brains was 2.0 ± 0.2 μg per gram of tissue. Five samples of the middle portion of the carp spinal cord, weighing between 55 and 80 mg, showed little or no cholinergic action on the heart. Thus the cholinergic substance in the caudal neurosecretory storage organ was found to be more than 100 times as concentrated as that in the brain of the carp. Of particular interest is the finding that the caudal storage organs of fresh-water fish contained about 10 times the amount of cholinergic substance found in those of marine fish.

The cholinergic substance in the caudal organ of the carp was present in both free and bound forms. The titers of free and total cholinergic substance based on another sample of 6 carp (30 to 35 cm body length) were 0.12 ± 0.01 μg (mean ± standard error) and 0.26 ± 0.04 μg per caudal organ, respectively. The difference between the concentrations of total and free cholinergic substance in a sample was taken to represent the bound cholinergic substance therein. The compound was completely inactivated by the treatment with 0.125*N* NaOH for 15 minutes at room temperature. It was promptly destroyed by boiling in alkaline liquids, but was resistant to boiling in acids. The heart, previously immersed for 30 minutes in 10 ml of sea water containing 0.25 mg of atrophine sulfate, did not show any response to the cholinergic substance in the homogenate. Unboiled homogenates prepared in distilled water (*p*H 7.0) lost completely the cholinergic action within 60 minutes of incubation at 37°C. This enzymatic destruction of the cholinergic substance was prevented when the tissues were homogenized in eserinized (10^{-5} g/ml) distilled water. After the inactivation of the cholinergic substance by NaOH or the endogenous enzyme, the homogenate had no effect on the heart beat. These data show that the cholinergic substance has characteristics in common with acetylcholine, and that the caudal organ of the carp contains acetylcholinesterase, and does not contain detectable amounts of excitor substances, such as 5-hydroxytryptamine.

Table 1. Cholinergic substance in the caudal neurosecretory storage organs of fresh-water and marine fish.

Species and number of fish	Body length (cm)	Weight of caudal organ (mg)	Cholinergic substance (μg/g tissue)*
	Fresh-water fish		
Cyprinus carpio (6)	30–35	1.1 –1.9	270 ± 59†
Carassius auratus (crucian carp) (3)	12–20	0.20–0.42	170 ± 33
Carassius auratus (goldfish) (3, 3)‡	13–15	.07–0.11	120, 190
	Marine fish		
Hexagrammos otakii (4)‡	21–33	.15–0.60	33
Lateolabrax japonicus (4)‡	29–33	.8 –2.2	19
Mylio macrocephalus (4)‡	22–28	.45–0.85	21

* Expressed as the amount of acetylcholine chloride which produces an identical heart response. † Mean ± standard error. ‡ In these fish, the cholinergic substance was assayed on total pools of 3 or 4 caudal storage organs and calculated per gram of tissue.

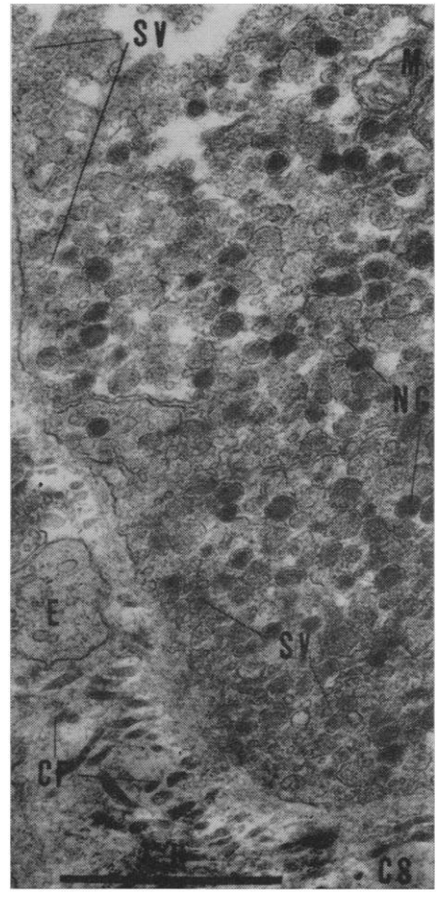

Fig. 1. Electron micrograph of the caudal neurosecretory storage organ of the carp. The tissue was fixed in osmium tetroxide-potassium bichromate and embedded in styrene. *CF*, collagen fibril; *CS*, perivascular connective tissue space; *E*, endothelial cell of blood vessel; *M*, mitochondria; *NG*, neurosecretory granule; and *SV*, synaptic vesicle. Heavy black line indicates 1 μ.

The fact that there are many synaptic vesicles and neurosecretory granules in the caudal neurosecretory storage organ of the carp (Fig. 1), as in other species of fish (*8*), may explain the high concentration of the cholinergic substance in this region. There are three possible sites of action of this compound: the membranes of the neurosecretory granules, the cell membranes of the axon endings, or the capillary walls. It is very probable that the cholinergic substance is involved in the control of neurohormone release from the caudal neurosecretory storage organ, although the biological action of the neurohormones of this organ has not been fully investigated. The difference in concentration of the cholinergic substance between the caudal organs of fresh-water and marine fish may be related to environment. Several investigators (*9*) have described the participation of caudal neurosecretory system in osmotic regulatory mechanisms in fish (*10*).

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Olfactory Receptor Response to the Cockroach Sexual Attractant

Abstract. *The recently isolated sex attractant of the female American cockroach elicits an electrical response in the antennae of males, females, and nymphs of this species. These electroantennograms are known to be summated receptor (generator) potentials of many olfactory sensillae stimulated simultaneously. Many other odorous substances also elicit such responses in the cockroach antenna.*

The isolation and identification of a sexual attracting substance from the female American cockroach, *Periplaneta americana* (L.), has been reported recently (*1*). The substance was found to be 2,2-dimethyl-3-isopropylidenecyclopropyl propionate. Its biological efficiency has been ascertained by use of a characteristic behavior of the males of this species (*2*) as bioassay (*1*).

Because it is known that the *Periplaneta* males detect this attractant with olfactory sense organs in the antennae (*2*), it was of interest to test the response electrophysiologically. This was done successfully with the electroantennogram (EAG)-method which proved useful in earlier investigations on olfaction in moths (*3*).

The thread-like antenna of the cockroach is not too well suited to recording summated olfactory receptor potentials known as "EAG's." Branched antennae of other insects give greater responses, thus permitting the testing of smaller amounts of odorous substances. As with moths, recording was either made from the isolated antenna or from the antenna of a living cockroach which had been mechanically fixed with adhesive tape and wire hooks on a cork plate so that the antenna could not move. Contact was made with glass capillary Ag-AgCl electrodes inserted into the distal and proximal ends of the antenna. The rather wide electrodes were filled with insect-Ringer solution and connected to a conventional d-c oscilloscope with a cathode-follower. EAG's were recorded on moving film. While isolated antennae survived amputation and EAG's could be recorded for some hours, it was possible to record such responses from the antennae of living insects for many days.

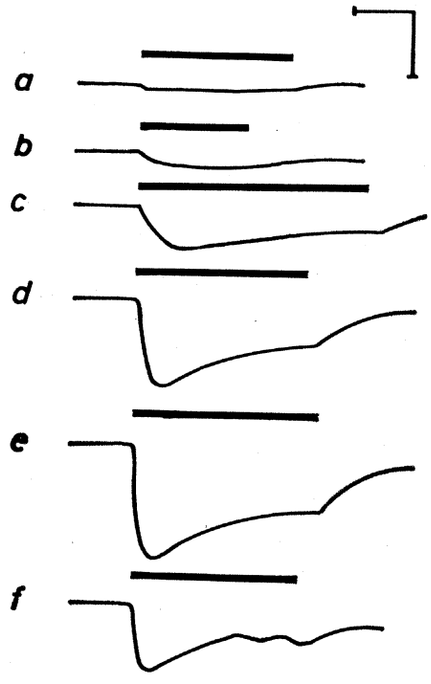

Fig. 1. Electroantennograms recorded from *Periplaneta americana* adult males in response to the chemically isolated sex-attractant odor of the female. Black bars above each trace indicate the duration of the odorous air current. Amount of natural product per cartridge: *a*, control (air without odor); *b*, 0.1 μg; *c*, 1 μg; *d*, 10 μg; and *e*, 100 μg; the cartridge *f* contained amyl acetate, 0.2 ml. Calibration: 1 mv, 1 sec.

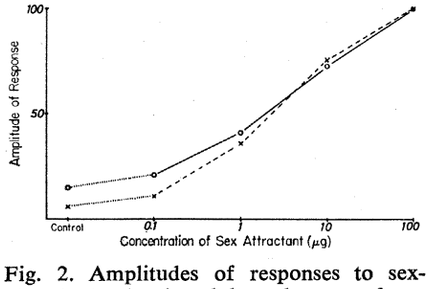

Fig. 2. Amplitudes of responses to sex-attractant odor in adult males as a function of stimulus concentration. Solid line: mean values of nine experiments, 100 μg amplitude set at 100 percent; broken line: amplitudes of the experiment demonstrated in Fig. 1.

Stimulation was accomplished by currents of air containing the odor. To achieve quantitatively constant stimuli, pieces of fluted filter paper were impregnated with a known amount of the substance to be tested. This paper was placed in short glass tubes (cartridges) mounted on the outlet of the air system in such a way that they could be easily exchanged. Air currents were controlled with a flowmeter and an electric valve, and were aimed at the whole antenna.

Figure 1 shows the result of such an experiment. In control experiments the cartridge contained only untreated paper. The amplitude of the response to the sex attractant increased in approximate proportion to the logarithm of the intensity of the stimulus (Fig. 2). By this method, the threshold concentration was found to be close to 0.1 μg per paper, when the air current was passed at a rate of 5 liter/min and the diameter of the tube was 6 mm. The distance between the air outlet and the antenna was 50 mm.

A number of other substances elicited similar responses. Amyl acetate, which, for the human nose, has an odor similar to that of banana, is known to attract cockroaches and always gave good responses.

The maximum amplitude of an EAG recorded from a female stimulated with its own sexual attractant was approximately 50 percent of that recorded from the male. However, both male and female antennae reacted very similarly to other odorous stimuli. In some instances, female antennae gave no response to the sex attractant but reacted well to other odors. Although there was some correlation between the length of the antennae and the amplitude of response, this can only be partly responsible for the weaker response of the female antenna to its own lure.

Antennae of nymphs of both sexes gave lesser responses than antennae of adults. However, the response to the concentrated sexual attractant, even in female nymphs, was still significantly greater than in the controls. This was also true for the antennae of older males in the larval stage. In female larvae the response was so small that no significant difference from the controls could be found.

A strong EAG response of a male insect antenna stimulated with the sexual attractant of its female was expected, and it was therefore rather astonishing that in the cockroach the female antenna likewise responds with