hormone mechanism must be considered, at least, as one of the mechanisms concerned in the normal evacuation of the gall-bladder. We propose the term "cholecystokinin" to designate the active principle which causes the gall-bladder to contract.

[1] Ivy, A. C. and Oldberg, Eric, PROC. SOC. EXP. BIOL. AND MED., 1927, XXV, 113.

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Influence of Narcotics on Ciliary Movement of the Gill of the Oyster.

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Ciliary activity is the simplest as well as the most widespread form of specialized contractile activity. The study of its physicochemical conditions is therefore of fundamental interest in relation to the general problem of the conditions of mechanical action in protoplasm. There have been, however, as yet relatively few quantitative studies in this field. One reason for this is the difficulty of exact measurement. In the ciliated epithelium of metazoa the movement is not integrated (as it is in muscular contraction). Each ciliated cell is automatic and independent in its activity, although the direction of effective stroke is typically constant and there is some transmission between neighboring cells. Nervous control is absent or difficult to demonstrate, although it has been observed in certain invertebrates (*e. g.*, veliger of nudibranchs as shown recently by Carter[1]). Control, reversal, and inhibition are best developed in the ciliate Protozoa; electrical sensitivity is also shown most clearly in this group (electrotaxis of Paramoecium, etc.). The cilia of Protozoa are, however, less favorable for studies of narcosis than cilia of a more automatic type, such as those of the ciliated epithelium of metazoa.

In the present study we have chosen cilia having a high degree of persistence, regularity, and automaticity in their movement, namely the cilia of the gill of the oyster, *Ostrea virginiana*. The gill was removed along the gill axis, and then teased into small pieces of about 3 to 5 mm. in width. There are different kinds of cilia in the gill, but the cilia along the ventral margin of the gill were exclusively used. Movement of these cilia can more easily be observed from the side. Five such pieces of gill were placed in each of a series of glass

vessels which contained 20 cc. of narcotic solutions of different concentrations in sea water. The vessel, which contained a sufficient free air space for oxygen supply, was covered and sealed with vaseline to prevent escape of narcotic vapor.

After varying periods of exposure, the cilia were observed in the solution, or the gill pieces were returned to sea water, which was renewed several times, and the result was observed on the next day. The temperature was kept at 20° ±1° C. The time of exposure required to narcotize the ciliary movement, and the maximum time of exposure which allows the movement to recover, in different concentrations of each narcotic, were determined. In comparing different compounds, the aim has been to determine as accurately as possible the range of concentration, for each compound, within which the arrest of movement is complete, while at the same time reversible after a period of inactivity lasting at least one hour.

The degree of reversibility varies greatly with different compounds. In general, the recovery of activity on return to normal sea water becomes less complete as the duration of the narcosis increases; *i. e.*, the narcotic or reversible action passes by degrees into a toxic or irreversible action at a rate increasing with concentration. The rate of toxic action, at the optimum narcotizing concentration, varies with the different compounds, some compounds such as

TABLE I.

Compounds	Narcotic Range, M.	Optimum Concentration, M.	Q
Alcohols:			
Methyl	3 -5	4	2
Ethyl	2±	2	3.3
n-Propyl	0.5 -0.75	0.6	3.2
n-Butyl	0.187-0.25	0.187	3.0
i-Amyl	0.062-0.093	0.062	(3.1 ?)
n-Heptyl	(0.0062 ?)	(0.0062 ?)	(1.9 ?)
Capryl	(0.0033 ?)	(0.0033 ?)	
Urethanes:			
Ethyl	0.5±	0.5	2.58
n-Butyl	0.08 -0.075	0.075	3.0
i-Amyl	0.025±	0.025	
Phenyl	*ca.* 0.004	*ca.* 0.004	
Nitriles:			
Aceto-	0.5 -1.0	1.0	2.0
Propio-	0.5 -0.75	0.5	2.0
n-Butyro-	0.2 -0.25	0.25	
Ketones:			
Methyl methyl	1.5 -2.0	1.5	
Methyl propyl	0.175-0.20	0.175	2.9
Methyl phenyl	0.025 ?	0.025 ?	
Chloral hydrate	0.1 -0.025	0.025	
Chloretone	0.01 -0.015	0.01	

chloral hydrate, aceto-nitrile, and chloretone being relatively non-toxic, while some others, *e. g.,* ketones, ethyl urethane, rapidly cause irreversible changes in the tissue. These differences appear arbitrary, just as do the analogous differences in the action of different anesthetizing compounds on higher animals.

Physiologically equivalent concentrations of the different compounds, *i. e.,* those in which there is cessation of movement lasting one hour or more and admitting of more or less complete revival, are given in the table.

In general the following features appear clearly from these experiments. In homologous series the optimum narcotizing concentrations decrease as the number of C-atoms in the chain increases, the numerical factor of increase, Q, on passing from one member to the next being typically between 2 and 3; sometimes larger than 3, *e. g.,* 3.3 with ethyl and propyl alcohols.

The rate of narcotic action also varies in the different members of a series, being in general slower with the higher members of the series. The rate of recovery is also slower in the higher members. This difference is probably to be related to the rate of diffusion. The optimum concentration is more sharply defined in the higher members of the series; *i. e.,* a slight increase above the optimum concentration in such compounds may render the effect irreversible.

[1] Carter, G. S., *Brit. J. Exp. Biol.,* 1926, iv, 1.