

Rubidium was tested in two fish at 1-1/2 and at 48 hours after injection of label. The mean k_{in} was 0.21 hr^{-1} (Table 4), similar to controls (Table 3).

HCO_3^- label was tested in two ways: 24 hours after acetazolamide (as for the other ions) and 30-40 minutes after giving the inhibitor. Six fish were used, divided equally between the two protocols. HCO_3^- label was analyzed in endolymph and plasma one hour after injection. Table 4 shows the rate constants calculated for both direct transfer of HCO_3^- and for $\text{CO}_2 \rightarrow \text{HCO}_3^-$, in the same manner as for the control data of Table 3. Following both prolonged and acute carbonic anhydrase inhibition, the k_{in} and accession rates are lowered. There are not enough data to tell if there is a real difference between acute and chronic inhibition.

The decrease in accession rate of HCO_3^- following acetazolamide (about 0.5 mM hr^{-1}), while significant, is not great enough in magnitude to show a measurable effect on cation accession rate (2.5 mM hr^{-1}) within the limits of variability in these experiments.

Conclusion

1. The endolymph composition suggests (in the absence of knowledge of the electrical potential) active processes for accumulation of K^+ , Cl^- and HCO_3^- .

2. The presence of carbonic anhydrase in the sacculus and canals, and the effect of acetazolamide upon HCO_3^- concentration and turnover in endolymph, show that the mechanism for HCO_3^- accumulation is that of hydroxylation of CO_2 , similar to that in aqueous humor, cerebrospinal fluid, and pancreas.

3. The Na^+ , K^+ , and Cl^- turnover in endolymph is of the order of 100-150 hours while that for HCO_3^- is about eight hours. However the concentrations of ions that are being moved are such that the actual rates of accession or exit are roughly the same (within two-fold) for all four ions.

4. Whether these characteristics extend to other vertebrates remains to be found, but at least two elements are shared with mammals: High endolymph [K] and carbonic anhydrase in the secretory tissue.

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1972 #2

NATURAL LEVELS OF DDT-RELATED COMPOUNDS AND POLYCHLORINATED BIPHENYLS (PCB's) IN VARIOUS MARINE SPECIES

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Because of the widespread distribution of chlorinated hydrocarbon residues in the environment and because of the importance of these materials to many investigators of this and other marine laboratories, we have extended and continued the determination of these materials (The Bulletin MDIBL, 9, 2, 1969; Ibid 10, 1, 1970) in various marine animals. All of the results presented in this report were from specimens collected from Frenchman Bay, Maine. Specimens were wrapped in aluminum foil, frozen in individual plastic bags and maintained in a frozen (-40°) condition until they were assayed. The DDT and related compounds were analyzed as described previously (The

TABLE 1
NATURAL LEVELS OF DDT-RELATED COMPOUNDS IN VARIOUS MARINE SPECIES*

Compound	Amount Found ppm						
	Egg Mass	Lobster Hepatopancreas	Carcass	Fundulus Whole	Flounder Whole	Eel Whole	Hagfish Whole
Wet Weight							
DDMU	0.28 (.17-.52)	0.09 (.04-.15)	0.03 (.03-.04)	0.045 (.04-.05)	0.03	0.25 (.17-.33)	0.14 (.11-.17)
pp'DDE	0.13 (.06-.24)	0.12 (.05-.19)	0.01 (.01-.02)	0.02	0.01	0.11 (.09-.12)	0.08 (.07-.09)
op'DDD	0.03 (.02-.04)	0.01	0.01	0.01	0.01	0.01	0.01
op'DDT	0.20 (.10-.42)	0.04 (.02-.08)	0.03 (.02-.03)	0.03	0.02	0.16 (.12-.19)	0.10 (.08-.12)
pp'DDD	0.03 (.02-.05)	0.04 (.02-.08)	0.01	0.01	0.01	0.01	0.05 (.01-.08)
pp'DDT	0.33 (.18-.65)	0.09 (.05-.17)	0.04 (.04-.05)	0.055 (.05-.06)	0.03	0.25 (.22-.28)	0.19
	Σ1.00	0.39	0.13	0.17	0.11	0.79	0.57
Fat Weight							
DDMU	23.2 (9.3-58.3)	0.89 (.44-1.66)	15.4 (5.72-20.3)	2.55 (2.26-2.84)	43.1 (29.8-62.4)	15.7 (13.4-17.9)	6.65 (4.31-8.99)
pp'DDE	21.4 (3.7-26.9)	1.12 (.53-2.07)	6.41 (2.29-8.3)	1.00 (.87-1.12)	20.6 (11.4-29.8)	6.71 (6.45-6.87)	3.84 (3.82-3.85)
op'DDD	1.84 (.89-4.20)	0.08 (.03-.10)	1.53 (.69-2.03)	0.28 (.26-.29)	4.94 (2.74-7.14)	0.50 (.40-.59)	0.34 (.30-.38)
op'DDT	17.4 (6.19-46.4)	0.38 (.17-.82)	12.1 (3.68-17.4)	1.65 (1.36-1.94)	25.7 (14.7-36.7)	10.08 (9.95-10.2)	4.75 (3.34-6.15)
pp'DDD	2.45 (1.19-5.59)	0.44 (.21-.87)	2.04 (.92-2.7)	0.36 (.34-.38)	6.59 (3.65-9.52)	0.67 (.54-.79)	1.93 (.51-3.34)
pp'DDT	26.8 (7.03-73.1)	0.90 (.53-1.8)	19.2 (6.7-26.6)	2.88 (2.48-3.27)	50.1 (29.2-71.0)	16.4 (15.3-17.4)	9.04 (7.88-10.2)
	Σ93.09	3.81	46.68	8.72	151.03	50.06	26.55

*Mean value for 2-4 animals; numbers in parenthesis are ranges of values. Where no ranges are given, replicate assays were equal.

Bulletin MDIBL, 9, 2, 1969), and according to Pesticide Analytical Manual, Vol. 1, 2nd edition 1968. The PCB assays were according to Armour and Burke (J. Assoc. Offic. Anal. Chem., 53, 261-268, 1970). In Table 1 it can be seen that the total amount of DDT-related compounds on a wet weight basis was considerably higher in the egg masses of the lobster than in the hepatopancreas. This reproductive organ in fact accumulates three times more of total DDT materials than does the hepatopancreas. The carcass, consisting mostly of skeletal muscle, contained only .13 total ppm of DDT. Of all the DDT analogs, pp'DDT occurred in the greatest amount as is to be expected considering the relatively inert nature of this compound and the fact that this is the form in which it usually enters the environment. The values for fundulus, a species relatively low in the food chain, are about the same as those values found in flounder. The average total values of DDT compounds in the eel were higher than those found in the hagfish. DDMU and pp'DDT accounted for most of the greater levels seen in the eel compared with the hagfish. The lower part of Table 1 reports the same values on a fat weight basis, because of the known concentration of these materials in lipid stores. The highest levels on a fat weight basis for total DDT materials occurred in the flounder. The next lower values occurred in the egg masses of the lobster followed, in decreasing order, by the eels, the carcass of the lobster and the hagfish. The significance of concentration in lipid compartments of animals, as brought out by these values when put on a fat weight basis, may be of importance in explaining the molecular basis for some of the toxic actions of chlorinated hydrocarbons in that these materials interact with phospholipids (Env. Health. Perspectives, 1, 169173, 1972; Science 174, 145-146, 1971).

TABLE 2

NATURAL LEVELS OF POLYCHLORINATED BIPHENYLS (PCB'S) IN VARIOUS MARINE SPECIES AND COMPARISON OF DDT/PCB RATIOS*

Compound	Lobster			Fundulus Whole	Flounder Whole	Eel Whole	Hagfish Whole
	Egg Mass	Hepatopancreas	Carcass				
PCB's, ppm Wet Weight	4.41 (2.78-5.98)	1.57 (1.13-2.27)	0.92 (0.07-0.13)	0.13	.013 (0.05-0.20)	1.09 (0.69-1.48)	0.47 (0.24-0.69)
PCB's, ppm Fat Weight	335.0 (157-501)	10.97 (8.92-12.2)	43.38 (13.7-67.7)	6.8	184**	54.0 (37.6-70.4)	23.29 (9.88-36.7)
Total DDT PCB Wet Weight	0.23	0.25	0.14	1.30	0.85	0.73	1.21

* Reported in terms of total PCB residues (Aroclor 1242 and 1254). Mean value for 2-4 animals except where noted; number in parenthesis are ranges of values. Where no ranges are given, replicate assays are equal.

** Single value only; other sample gave fat weights too low to measure accurately.

These same tissues were analyzed for PCB's, another group of long-life, widespread chemicals in the environment (BioScience 20, 958-964, 1970), and these results are found in Table 2. In terms of wet weight the highest values were found to occur in lobster egg masses. The lobster hepatopancreas and carcass also contained large amounts of PCB's. The eel had about 1 ppm of these materials whereas the hagfish had about one-half this quantity. As in the case of DDT, the fundulus and flounder had comparable levels. In terms of PCB's on a fat weight basis, there is extensive concentration observed in this compartment. The egg masses again contained the highest concentration followed by the flounder, eel, lobster carcass, and hagfish. The use of DDT/PCB ratios has been proposed as a means of determining the natural history of contamination of marine species (Bull. Env. Contam. and Tox. 7, 223-228, 1972). According to this concept, ratios of unity suggest that contamination of the marine environment by these two chlorinated hydrocarbons occurred at the same point in time. Higher ratios thus suggest initial contamination by DDT, low ratios recent contamination by PCB's. The low ratios indicated on the bottom of Table 2 imply that the intake of these materials for the lobster, a scavenger, is from materials contaminated more recently with PCB's than DDT's. The DDT/PCB ratios for all other species in question do not appear to be significantly far enough from unity to suggest anything other than simultaneous contamination by these pollutants.

1972 #3

DISTRIBUTION OF ^{14}C -2,4,5,2',5'-PENTACHLOROBIPHENYL IN THE LOBSTER, *Homarus americanus* AFTER INTRAVASCULAR ADMINISTRATION

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The polychlorinated biphenyls (PCB) possess high thermal and chemical stability in addition to a high dielectric constant. Due to these properties substantial quantities of PCB are used industrially. PCB residues are fairly widespread in the environment and have been detected in human adipose tissue (Price and Welch, Env. Hlth. Persp. 1, 73, 1972). Commercially available PCB are complex mixtures containing many isomers of varying chlorine content. For example, Aroclor 1254 has been separated into more than fifty components, of which the pentachlorobiphenyl isomers appear to be the chief constituents (Sissons and Welti, J. Chromatog. 60, 15, 1971). The distribution of radio-labeled 2,4,5,2',5'-pentachlorobiphenyl was investigated in the lobster since the data obtained should be representative of several, if not all, Aroclor 1254 components. In addition, the results could be compared with those reported earlier for DDT disposition in the lobster (Guarino, Pritchard, Call, Bering, Rall, Bull MDIBL 11, 29, 1971).

Adult lobsters of mixed sex weighing 360-560 g were purchased locally (Lunt's Lobster Pound, Trenton, Maine). 2,4,5,2',5'-Pentachlorobiphenyl - (2',5'-dichlorophenyl- ^{14}C) (^{14}C -PCB), 10.08 mCi/mM was obtained from Mallinckrodt. ^{14}C -PCB (0.20 mg/kg; 14.0×10^{12} dpm/kg) was injected into the pericardial sinus of the lobster as a solution in Emulphor-water (18 percent v/v).