INVESTIGATION OF POLYCHLORINATED
BIPHENYLS IN THE HUDSON RIVER

(HUDSON FALLS - FT. EDWARD AREA)

Report Prepared By: Royal J. Nadeau and
Robert P. Davis

Report Approved By:

Royal J. Nadeau, Ph.D.
Chief, Biology Section

Francis T. Brezenski
Chief, Technical Support Branch
Surveillance & Analysis Division

Introduction..... 1

Materials and Methods

Description of Sampling Area - Hudson River..... 4
Chemical Analysis - Water..... 5
Chemical Analysis - Sediment..... 5
Chemical Analysis - Biota..... 6
Histology..... 7

Results

Field Observations..... 7
Chemical Analysis - Water and Sediments..... 8
Biological Tissue..... 10
Histopathology..... 11

Discussion..... 12

Conclusions..... 15

Recommendations..... 15

Tables

Table 3 - Biota Collected During the Hudson River Investigation..... 16

Table 4 - Analysis of Water and Sediment Samples of Aroclor 1016 from the Hudson River in the Area of Fort Edward, New York..... 17

Table 5 - PCB Concentrations in Snails and Fish Above Baker's Falls (Control Area) on the Hudson River..... 18

Table 6 - PCB Concentrations in Snails and Fish Below the General Electric Discharges on the Hudson River..... 18

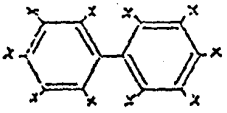
Table 7 - Concentration Factors of PCB's in the Hudson River.. 19

Literature Cited..... 20

Figures

Figures 1 through 28

Polychlorinated biphenyls (PCB's), only as recently as 1966, have been realized as an environmental contaminant. Primarily used in industry, PCB's are even more persistent than DDT. These compounds are essentially non-alterable by microbial or physical-chemical activities and are incorporable into living protoplasm. The molecular structure given below inhibits enzymes, presently found in natural cellular systems, from shearing the bonding between the chlorine atom and the biphenyl structure.



x = Cl bonding sites

Paradoxically, this same structure gives specific chemical characteristics very desirable for certain industrial uses, i.e. manufacturing of plastic resins and varnishes.

PCB's not only are incorporable into living biomass in natural ecosystems but are transferable within food webs; the end result being a much higher concentration of these compounds occurring in specific tissues of summit carnivores (biomagnification). Occurrence of PCB's in human tissues has been documented especially in people who are constantly exposed to PCB's through their occupation or life styles. Even though these compounds have a comparatively low acute toxicity for mammals, the long term effects may be much more insiduous and devastating. A number of investigators have shown that PCB's induce production of liver microsomal enzymes. Others have shown that PCB's can decrease Vitamin A content in the liver (Cecil, et al, 1973). Transplacental passage of PCB's has also been shown (Grant, et al, 1971). PCB's have been detected in human adipose tissue in such widespread occurrence that 41-45% of the U.S. population contains 1 ppm or more (Price & Welch, 1972).

MONS 047523

It has been estimated that 4 to 5 x 10^3 tons/year of PCB's are lost into the nation's fresh and coastal waters (Risebrough and Sarofim, 1972). An indication of the widespread contamination of PCB's in today's society is illustrated in the Temporary Tolerance Limits set by the FDA in certain food products (Kimsbrough 1974).

TABLE 1. Temporary Tolerance Limits of PCB's

Substrate	Level (ppm)
Milk (fat basis)	2.5
Dairy Products (fat basis)	2.5
Poultry (fat basis)	5.0
Eggs	.5
Complete and finished animal feeds	.2
Animal feed components	2.0
Fish and shellfish (edible portion)	5.0
*Paper food-packaging material	10.0

The Water Quality Criteria of 1972 (EPA, R3-73-033, March 1973) does make recommendations on the basis of body accumulation of PCB's. Estimates indicate that 41 to 45 percent of the general population in the U.S. may have levels of 1.0 mg/kg or higher (wet weight) in adipose tissue. It therefore was calculated that a daily intake of 0.02 mg would require about 70 years to be toxic. Utilizing a safety factor of ten would permit a daily intake of two micrograms. In general, the average person drinks two liters of water per day. With this intake a permissible concentration in water would be one ug/l.

PCB's in Region II

The General Electric facilities at Hudson Falls and Ft. Edward, New York report PCB's in their effluents (TABLE 2).

* Does not apply to packaging material that is separated from the food by a barrier impermeable to PCB migration.

MONS 047524

TABLE 1. PCB, oil and grease in General Electric effluents
(Source: NPDES Permit Applications)

Number	Outfall Location	Daily Average Concentration (mg/l) Oil/Grease	PCB	Average Daily Loading (lbs.) Oil/Grease	PCB	Maximum Daily Loading (lbs.) Oil/Grease	PCB
002	Hudson Falls	13.7	.5	239.8	10.0	250.9	17.5
003	Hudson Falls	2.1	---	4.9	----	5.25	----
004	Ft. Edward	8.9	5.0	38.27	20.0	44.5	30.0

* Oil and grease is listed being that PCB's are extremely soluble in the oil and grease component of a waste stream; oil and grease serves as a carrier of PCB's into the receiving waters.

PCB's are used in large quantities for filling capacitors and transformers manufactured and assembled at both the Hudson Falls and Ft. Edward facilities. Both plants have waste treatment processes for removal of chemicals, however, significant PCB and oil and grease levels still remain in the waste stream (TABLE 2). To date no water quality standards have been promulgated specifically for PCB compounds, making it difficult to initiate an enforcement action on the basis of the loading and effluent discharge concentration alone. The approach being used by the Region II Enforcement Branch (see attached memo: Sandra Kunsburg) is, that the discharge from the General Electric facility may be presenting a health hazard within the meaning of Section 504 of the FWPCA. Within this Section, a suit can be brought against the discharger if it can be shown that the discharger is presenting an imminent and substantial endangerment of the health of persons through the ingestion of water or food contaminated from the discharge.

The Biology Section was requested to submit a plan of action and scope-of-work for performing an investigation, in the vicinity of the General Electric facilities, to determine the presence and extent of contamination of water, sediments and biota of the receiving waters, the Hudson River.

MONS 047525

Description of Sampling Area - Hudson River

Station 0

Station 0 is located .5 miles above Baker Falls in the impoundment area (FIGURES 1 & 2). This station is upstream and separated from both General Electric facility outfalls by a hydroelectric dam (height - 15 m). At sampling time (3:15 pm, August 12, 1974) the water was heavily laden with fibrous particulates being carried down from an upstream source. Several paper mills and fiber board manufacturers are located in Glens Falls, 3-5 miles upstream from Station 0. In the main channel area the bottom is hard shale. In the shallows where water velocity is less, large deposits of sediments intermixed with bark, branches, lumber slabs and cinders are found. A sediment sample was taken by coring into the sediments with a glass sampling jar and capping it underwater. A subsurface water sample was taken nearby.

A seine was used to collect fish near a patch of emergent vegetation on an opposite bank from the sediment deposits (east bank). The gastropod (snail) populations associated with the emergent vegetation were sampled simultaneously.

Station 1

Station 1 is located at the junction of the outfall stream from the Ft. Edward facility and the Hudson River (FIGURE 3). At this point, the Hudson River is a roaring, turmoilous river with a high velocity, high volume streamflow (4466 cfs)*. The river is heavily laden with heavy suspended loads of fibrous material. Water and sediment samples were taken at this point in the same manner as at Station 0 (9:15 am, August 13, 1974). The sediment sample was taken from a small submerged cinder-gravel spit right at

*Calculated from N.Y. State Water Resources Data Book 1971.

the outfall junction. An upstream gastropod population was sampled several meters above the junction. This station is only accessible by boat in that the river banks are precipitous shale rock faces, 15 m in height. This is the only accessible outfall being that the upstream Hudson Falls facilities cannot be reached by foot or boat.

Station 2

Station 2 is located about 0.25 miles downstream from the outfall junction (FIGURE 4) where water and sediment samples were collected (10:00 am, August 13, 1974). River flow conditions are the same as at Station 1. No macroinvertebrate or piscine populations were observed at this station. The water is laden with the same fibrous suspended materials as evidenced at Station 0. The river bottom is mainly a shale ledge. A sediment sample was collected from a remnant shale flake, cinder deposit bank above the high water mark. All the collecting sites downstream from Baker Falls were submerged until September 1973 when an abandoned hydroelectric dam at Ft. Edward was removed. The water level was drastically lowered, 5-15 meters.

Station 3

Station 3 is located about 0.5 miles downstream from Station 1, water and sediment samples were collected (11:00 am, August 13, 1974). In this area an extensive sludge bank exists as a remnant of an industrial era gone by. The bank sediments consist of gravel, cinders, lumber slabs and bark from logging activities, forty years ceased (FIGURE 5). The sediment sample was collected from a submerged deposit near the same area where several fish were collected by seining (FIGURE 6). In the shallow area, the fibrous material, suspended at the upstream stations has flocculated onto the river bottom, coating the bottom with a paper wrapping (FIGURE 7).

MONS 047527

Station 4

Station 4 is located 0.75 miles downstream from Station 1. The river is slightly wider at this point with decreased velocity. Fish populations are abundant in the shallow shoreline areas. These populations were sampled by seining (FIGURE 8). Water and sediment samples were collected in the river, three (3) meters upstream from the junction of a small stream that flows in on the west shore (1:15 pm, August 13, 1974) (FIGURE 9).

Chemical Analysis - Water*

A measured volume of sample was extracted with hexane. The extract was dehydrated, concentrated and analyzed by computerized gas chromatography/mass spectrometry (GC/MS).

Sediment**

The sediment sample was partially dried and extracted by column elution with a mixture of 1:1 acetone/hexane. The extract was washed with water to remove the acetone and then the polychlorinated biphenyls were extracted from the water with 15% CH_2Cl_2 in hexane. This extract was then dehyrated, concentrated to a suitable volume and analyzed by computerized GC/MS.

Biota (See attached memos: Gilman D. Veith, Ph.D.)

The samples were blended with anhydrous sodium sulfate (prewashed with redistilled acetone) and the homogenate was extracted with a mixture of hexane and ethyl ether (3:1 v/v). The extracts were placed on a 20 gm

*Methods for Organic Pesticides in Water and Wastewater 1971. Environmental Protection Agency, National Environmental Research Center, Cincinnati, Ohio.

**Analysis of Pesticide Residues in Human and Environmental Samples 1961. Perrine Primate Research Laboratories. Environmental Protection Agency, Perrine, Florida, Section 11B:1-6.

MONS 047528

the cell column, eluted with 25 ml of acetone, and the volume of the eluate was adjusted so the final concentration of PCB's was within the linear range of the gas chromatograph. The sample of rock bass from the discharge required a 50 fold dilution before analysis.

The presence of PCB's in all samples was confirmed by perchlorinating the samples with $SbCl_5$ for four hours at 170°C to form $C_{12}Cl_{10}$. The $C_{12}Cl_{10}$ was subsequently analyzed by gas chromatography using a three foot column of 3% Dexsil-300 at 200°C.

Subsequently, a GC/MS analysis of the rock bass extract was performed along with analysis on Aroclor 1016 and 1242 standards.

Histology

Four (4) specimens were collected from Station 0 (control) and Station 4 and preserved for histological examination. These specimens were representative of the Northern Common Shiner, Notropis cornutus frontalis populations found at each station. The fins and tail were excised and the whole specimen embedded in paraffin in preparation for sectioning. After sectioning, selected sections were mounted and stained*.

RESULTS

Field Observations

A specular observation at Station 1 is the oil on water plume resulting from the confluence of the waste stream and the Hudson River (FIGURES 10 & 11). The plume is visible 20-30 meters before being completely emersed and broken by the turbulent river waters. At the same time a pungent kerosine odor is

*Staining method supplied by Mr. Rudd Douglas, Department of Zoology, Rutgers University, New Brunswick, New Jersey.

MONS 047529

discernable in the immediate outfall area of the waste stream. The shale-cobble river bank (FIGURE 12) is splattered and penetrated by oil and grease from the effluent.

Gastropods were collected for analysis above the outfall river confluence; however, downstream no visible signs of attached or other forms of aquatic life were evident as far as one can easily negotiate walking along the steep river bank (approx. 200 meters). At Station 2, a similar lack of attached forms was evident. At Station 3 several small fish were collected in the shallows (TABLE 3).

At Station 4 the bank consisted of shale ledges forming several shallow shoal areas running diagonally into the mainstream. Sediments are deposited in the shallows. The organics brought downstream sustain a diverse gastropod population, represented by Physa, Heliosoma, and Limnaea. A seine haul in these shallows produced an abundance of common shiners, Notropis cornutus frontalis (Agassiz).

The ecology of the Hudson throughout the sampling area (Station 0 being the exception) has been drastically altered by the destruction of the impoundment once formed by the Niagara Mohawk hydroelectric dam at Ft. Edward. Once the ecology resembled that typical of any impoundment, pond or lake; submergent-emergent vegetation communities along the edge and deep water communities in the middle. In its place now is a rushing, roaring river that has cut new channels through the bottom deposits, exposing once buried trees, logs, several model T's, baby carriages and boulders (FIGURES 13 & 14). Needless to say, the biomass and community structure is rather sparse and deprived.

Chemical Analysis

Water & Sediments

Qualitative detection of PCB's in water and sediments was accomplished

MONS 047530

by computer computerized GC/Mass spectra of various Aroclor mixtures including 1016 supplied by General Electric and Research Triangle Park with environmental sample extracts. A gas chromatogram (FIGURE 15) revealed the high concentration of trichloro biphenyl compounds characteristic of Aroclor 1016 mixture. The mass spectra of Aroclor 1016 compounds were then compared with those extracted from the water and sediments.

PCB's identified as Aroclor 1016 were found in the water samples at detectable concentrations at all sampling locations except Station 0 (control) and Station 4 (furthest downstream) (TABLE 4).

The highest concentration of Aroclor 1016 in water was 2800 ug/l at the outfall site. The downstream stations, (2-4), however, demonstrate low levels of PCB's. These low levels are largely a result of effluent concentrations being dispersed by river water.

At all stations the sediments contained higher concentrations of Aroclor 1016 than the water column resulting from adsorption of PCB's on suspended or already settled materials. At Station 2 the contamination must have occurred prior to the removal of the hydroelectric dam. The sample site has not been inundated for at least a year.

The high contamination level at Station 1 indicates the adsorptive capacity and constant exposure of the sediments nearest the outfall to the Aroclor 1016. These sediments were also heavily laden with noticeable oil and grease which serves as a solvent for PCB compounds.

At Station 3, high concentrations (2980 mg/kg) occur in the sediments, representing accumulated levels of PCB's, 10^3 fold greater than the outfall concentration. The high level is a product of historical plus present adsorption and deposition of PCB compounds. The PCB level at Station 2

sediments historical deposition trend. Although water column levels are below detectable limits at Station 1, PCB's occur in significant quantities in the sediments. These concentrations must be considered background levels in that similar levels occur at the control area as well.

Biological Tissue

Station 0

The samples collected above the discharge contained the later-eluting PCB's with retention times of 84, 98, 104, 112, 125, 146, and 174 relative to pp DDE. These are characteristic of Aroclor 1254. In addition, major PCB components were found at relative retention times of 37, 40, 47, 54, 58, 70, and 78. FIGURE 16 presents a chromatogram of a control station sample and the major components are enumerated by relative retention time. The relative concentration of the PC3 components together with the absence of PC3 components eluting earlier than 28 suggest that the PCB's in these samples can best be estimated as a mixture of Aroclor 1254 and Aroclor 1248. Using the later-eluting components with Aroclor 1254 and the earlier major components with Aroclor 1248, the PCB concentrations in the control samples were estimated and are presented in TABLE 5.

Distinctly different from the samples from the control area were the samples collected in the vicinity of or below the General Electric discharge. FIGURE 17 presents a chromatogram of the sample of bass below the discharge and it is evident there are no major PC3 components eluting after 78 relative to DDE. Moreover, the 21, 28, and 32 components are greatly enriched relative to the 37 component. This suggests that Aroclor 1242, Aroclor 1016, or a mixture of these two formulations are present in the Hudson

MONS 047532

were below the General Electric discharge. FIGURE 18 compares the total ion currents of the Hudson River rock bass extract with those of Aroclor 1242 and Aroclor 1016. The mass chromatograms are similar with the exception of the peak eluding at spectrum 130. FIGURE 19 shows the mass chromatograms for the characteristic ions of trichlor PCB as can be seen by the comparison of the mass chromatograms of the rock bass with those of Aroclor 1242 and 1016. There are no distinguishing features which can reliably determine whether the mixture in the fish is Aroclor 1016 or 1242. FIGURE 20 presents the mass chromatograms of the pentachloro PCB's and shows that only trace amounts of the pentachloro PCB's were present in the fish sample. The number of isomers of pentachlorobiphenyls is greater in Aroclor 1242 than in 1016. These same PCB isomers occur in the rock bass extract suggesting that the fish contain an Aroclor other than 1016. TABLE 6 presents the PCB concentrations as Aroclor 1242 in the samples below the discharge. The data shows that the PCB concentration ranged from 78 ug/gm in the minnows to 350 ug/gm in the composite sample of two bass. The PCB concentrations in snails were 45 ug/gm and 27 ug/gm at Station 1 and Station 4, respectively. Because of the dilution of the extracts for these analyses, the concentrations of other PCB mixtures were not quantitated; however, the concentration of Aroclor 1254 was below 5 ug/gm in these samples collected below the discharge.

Histopathology

No noticeable differences were present in the histomorphology of tissues examined from fish collected from the control area (Station 0) and from the sampling site .75 miles below the General Electric outfall (Station 4)

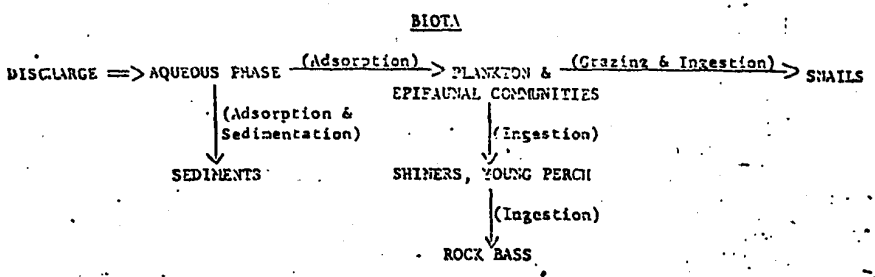
MONS 047533

even with minor difficulties encountered during tissue preparation and staining procedures, microscopic examination of kidney, liver, gonad and digestive tract did not show histological aberrations in either group (FIGURES 21 to 23).

DISCUSSION

The PCB's being discharged are in sufficient quantities that contamination of all environmental substrates have occurred; water, sediments and biota.

Although an exact accumulation and transfer model could not be determined for the sampling area, a hypothetical presentation is given below:



At all stations the biota has higher levels of PCB's than the background water concentration. At all stations, except Station 3, the biota contained higher levels of PCB's than the sediments.

At all stations the snail populations are important accumulators and concentrators of PCB's (TABLE 7). The species collected are primarily herbivorous grazers, living off the periphyton growing on rocks, lumber slabs and benthic surfaces. The snails probably ingest sedimented materials containing adsorbed PCB's along with their natural food.

MONS 047534

In this manner, the ingested PCB's remain biologically active and can be biomagnified within the food web since snails are normal dietary constituents of larger game fish. This is a possible pathway for biomagnification. Likewise, the PCB's are remaining environmentally active and are not becoming deactivated by the geologic sedimentation process.

A confusing issue is that Aroclor 1016, although definitively analyzed in water and sediments by computerized GC/MS, was not clearly discerned in the biological tissues. This problem is particularly bothersome for interpretating the meaning of the contamination levels relative to Section 504 (FWPCA). If the PCB's in the biological tissues could not be identified as Aroclor 1016 which supposedly is the only PCB now being discharged by General Electric at the Hudson Falls and Ft. Edward facilities, then what other possible source might there be? It is possible from the variety of industrial uses documented, that PCB's are being discharged into the Hudson River upstream of the General Electric plant. From the contamination levels in sediments at Station 0, other sources of PCB's, even Aroclor 1016, exist in the Hudson River.

It is entirely possible that the paper companies operating upstream are discharging PCB's. These compounds are found in printing inks as well as non-carbon copying papers and recycled fiber paperboard; averaging 6.4 ppm (Trout, 1972).

The PCB levels, expressed as whole body residue, in the minnows collected from Station 0 (7.0 ug/g) and Station 4 (78 ug/g) were not sufficient to elicit a histomorphological response in the visceral tissues. Hansen et al (1974) reports that pinfish (Lagodon rhomboides) exposed to 10 ug/l of Aroclor 1016 for 42 days showed no histopathologic response in visceral tissues as compared to the control fish. The body burden of PCB's in the exposed fish was 111-170 ug/g wet weight; significantly greater

MONS 047535

than the levels found in the minnows collected from each location at and Station 4. From the literature search, we could not find documentation of the body burden levels of PCB's necessary to elicit a histopathological response in the common shiner (Notropis cornutus cornutus).

The PCB level in the Perca flavescens (Yellow Perch) at Station 0 is 68 times greater than that found in the same species from Lake Erie (Kelso & Frank, 1974). The fish analyzed in the Lake Erie study were older and larger than those collected in the Hudson River. The most probable route of contamination for fish is through the dietary pathway and direct diffusion across exposed gill, intestinal and integument surfaces. If the perch collected at Station 0 were older and larger, their source of PCB's might be the snails, however, small perch are mainly plankton and epifauna consumers (Tharratt, 1969).

It is significant that the shiners and snails both contained PCB's, expecially since these species are important grazers upon periphyton communities and serve as food for large consumers, namely the game fish; i.e., pike, pickeral, bass and larger yellow perch.

The PCB level in the rock bass is greater than the maximum level documented for fish taken from any industrial river of the U.S. (Nisbet & Sarofim, 1972). This represents a new record for PCB contamination of fresh water fish.

Although the game fish species are not commercially utilized in this stretch of the Hudson, sport fishing is a common widespread recreational activity for the inhabitants of Hudson Falls and Ft. Edward. Undoubtedly, the area was utilized to a greater extent prior to the destruction of the impoundment. Certain areas, particularly downstream from Station 4 are

MONS 047536

fished primarily by the youngsters of Ft. Edward. Ingestion of these fish by the people would certainly lead to contamination of specific tissues in their bodies as documented by previous investigators mentioned in the introductory section of this report.

CONCLUSIONS

1. The General Electric facility at Ft. Edward is discharging large concentrations of Aroclor 1016 with oil and grease. The high levels of contamination in the downstream sediments is probably from the Ft. Edward outfall.

2. Other sources of Aroclor 1016 are present upstream from the General Electric outfalls.

3. The biotic components of the river ecology are heavily contaminated with PCB's, grazing populations as well as carnivorous piscine populations. The exact source of the PCB contamination in the upstream contamination is unknown. For the downstream communities, the contamination is probably from the General Electric outfalls.

4. Man could possibly become contaminated by ingestion of piscine populations taken from the sampling area.

5. The General Electric facility at Ft. Edward is a contributory source of PCB's to this waterway, and not a sole source.

RECOMMENDATIONS

Depending on how enforcement action proceeds, it may be appropriate to obtain additional data on the distribution of Aroclor 1016 in fish, snails and sediment above and below the General Electric's outfall. Also, an investigation of other sources of PCB discharges should be conducted to delineate the extent of contamination in the Hudson Falls areas.

MONS 047537

TABLE 3

Biota Collected During the Hudson River Investigation
(Hudson Falls-Ft. Edward Area)

Location	Piscine Name	Number	Gastropod Name	Number
Station 0	Notopis cornutus frontalis (Agassiz) (Northern Common Shiner)	31	Helisoma sp	35
	Perca flavescens (Mitchell) (Yellow Perch)	4	Physa sp	1
Station 1 (Above Outfall)	None		Helisoma sp Physa sp	4 24
Station 3	Ambloplites rupestris rupestris (Rainesque) (Northern Rock Bass)	2	None	
Station 4	Notropis cornutus frontalis (Agassiz) (Northern Common Shiner)	42	Helisoma sp Physa sp Limnaea sp	1 60 19

MONS 047538

TABLE 4

Analysis of Water and Sediment Samples for Aroclor 1015 from the Hudson River in the Area of Fort Edward, New York

Location	Contamination Levels	
	Water ug/l (ppb)	Sediment mg/kg (ppm)
Station 0	< 1.0	6.9
Station 1	2800.0	6700.0
Station 2	2.2	540.0
Station 3	(3.0)* (3.1)	2980.0
Station 4	< 1.0	6.6

*Results of replicate analysis - a quality assurance procedure.

MONS 047539

TABLE 5

PCB Concentrations in Snails and Fish
Above Baker's Falls (Control Area) on the Hudson River

Region II Lab Number	Sample	PCB Concentration (ug/gm-wet) Aroclor 1254	Aroclor 1248	Total PCB
46031	4 Yellow Perch	4.0	13.0	17.0
46031	131 Shiner Minnows	2.0	5.0	7.0
46031	Snails (composite)	0.3	1.6	1.9

TABLE 6

PCB Concentrations in Snails and Fish
Below the General Electric Discharges on the Hudson River

Region II Lab Number	Sample	PCB Concentration (ug/gm) (as Aroclor 1242)
46035	1 Rock Bass	350
46036	42 Shiner Minnows	78
46033	Snails (Composite)	45
46036	Snails (Composite)	27

MONS 047540

TABLE 7

Concentration Factors of PCB's in the Hudson River

Location	Substrate	Concentration Factor	
		Tissue/Water	Tissue/Sediment
Station 0	Snails	1.9×10^3	3.63
	Common Shiner	7.0×10^3	.98
	Yellow Perch	17.0×10^3	.41
Station 1 (Above Outfall)	Snails	45×10^3	6.52
Station 3	Rock Bass	117×10^3	.12
Station 4	Snails	27×10^3	11.82
	Common Shiner	78×10^3	4.09

MONS 047541

Anon., 1971.
Water Resources Data for New York Part 1. Surface Water Records, U.S. Geological Survey, 311 pgs.

Cecil, H.C., Harris, S. J., Bitman, J. & J. F. Fries, 1973.
Polychlorinated biphenyl induced decrease in liver vitamin A in Japanese quail and rats. Bull. Env. Contam. Toxicology 9:179.

Grant, D. L., Villeneuve, D. C., McCully, K. A. & W. E. J. Phillips, 1971.
Placental transfer of polychlorinated biphenyls in the rabbit, Environ. Physiol. 1:61.

Hansen, D. J., Parrish, P. R., and Forester, J., 1973.
Aroclor 1016 : Toxicity to and uptake by estuarine animals. Contritrition No. 172, Gulf Breeze Environmental Research Laboratory.

Kelso, John R. & Richard Frank, 1974.
Organochlorine residues, mercury, copper and cadmium in yellow perch, white bass and smallmouth bass, Long Point Bay, Lake Erie. Trans. Amer. Fish. Soc. 103(4):577-581.

Kimbrough, R. D. 1974.
The toxicity of polychlorinated polycyclic compounds and related chemicals. Critical Reviews in Toxicology 2 (4):445-493.

Nisbet, I. C. T. & A. F. Sarofim, 1972.
Rates and routes of transport of PCB's in the environment. Env. Health Perspectives, Experimental Issue, April 1972.

Price, H. A. & R. L. Welch, 1972.
Occurrence of polychlorinated biphenyls in humans. Env. Health Perspectives, Experimental Issue No. 1, April 1972.

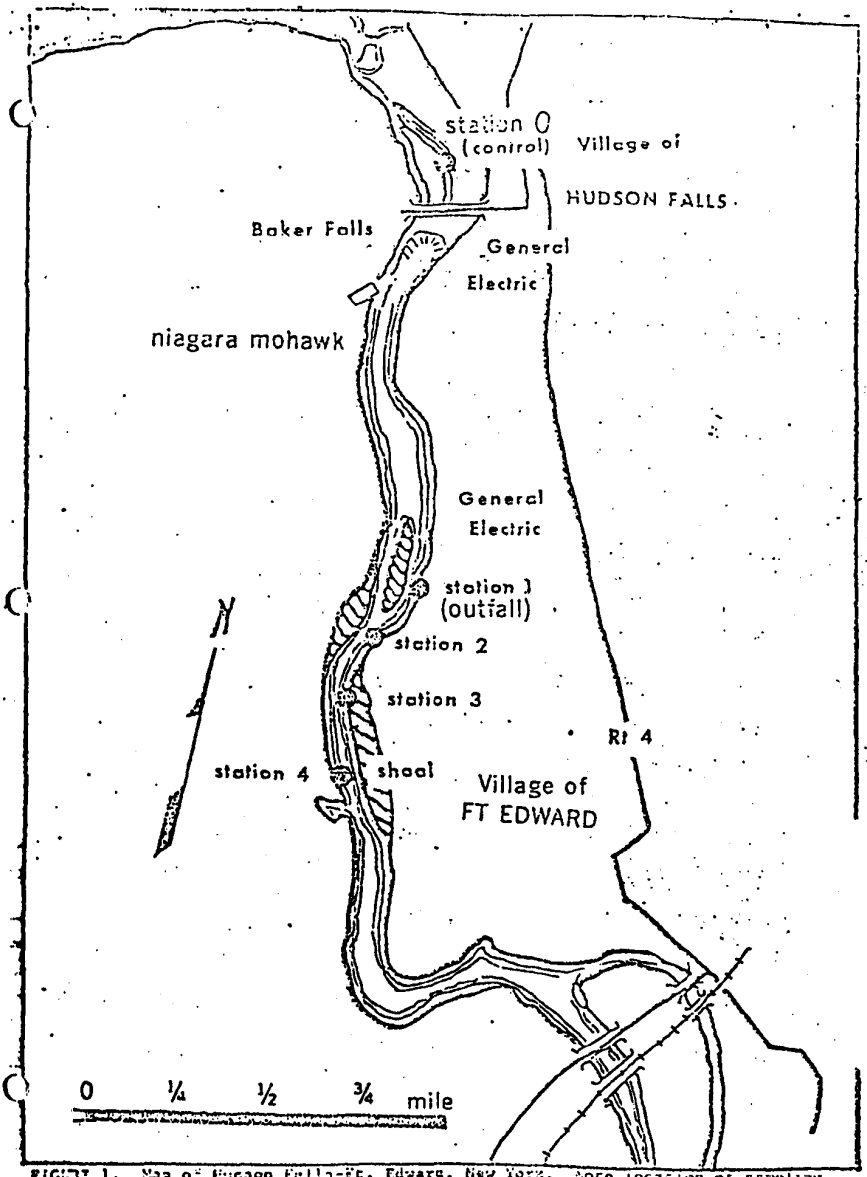
Tharratt, R. C. 1959.
Food of yellow perch, Perca flavescens (Mitchell) in Saginau Bay, Lake Huron. Trans. Amer. Fisheries Soc. 88(4):330-331.

Trout, P. E., 1972.
PCB and the paper industry - a progress repot. Env. Health Perspectives Experimental Issue No. 1, April 1972.

MONS 047542

Table 2. PCB Concentrations in Snails and Fish
Below the G.E. Discharges on the Hudson River

Region II Lab Number	Sample	PCB Concentration(ug/gm) (as Aroclor 1242)
46035	1 Rock Bass	350
46036	42 Shiner Minnows	78
46033	Snails (Composite)	45
46036	Snails (Composite)	27



MUNS 047544

FIGURE 1. Map of Hudson Falls-Ft. Edward, New York. Note location of sampling stations relative to General Electric facilities.

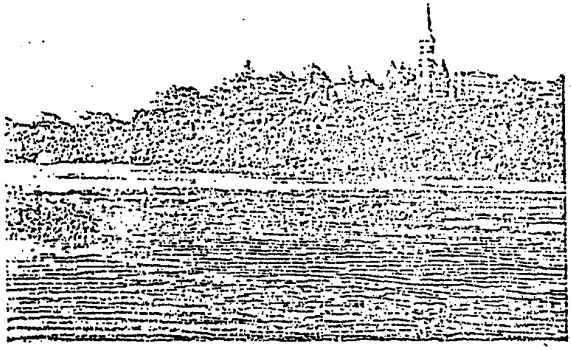


FIGURE 2. Control Station (Station 0). Note emergent vegetation and lumber slab deposition in foreground.



FIGURE 3. Outfall structure from General Electric facility - Ft. Edward, New York.

MONS 047545

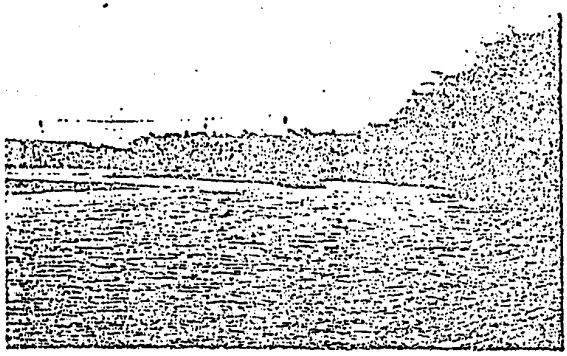


FIGURE 4. Upstream sludge banks as viewed from Station 2, General Electric outfall is located slightly to right of middle.

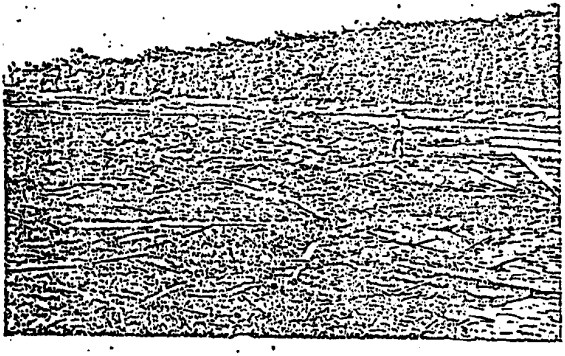


FIGURE 5. Downstream view from Station 3. Note lumber debris buried in sludge on left.

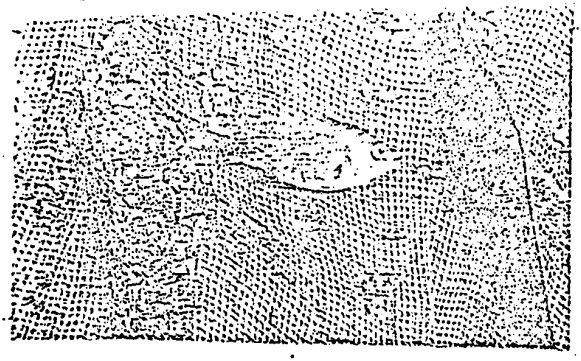


FIGURE 6. Northern Rock Bass (Ambloplites r. rupestris) collected at Station 3.

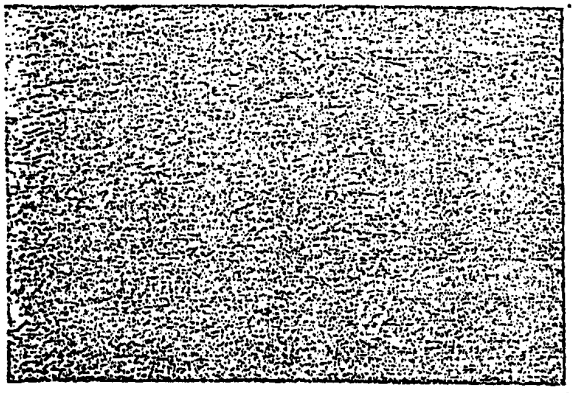


FIGURE 7. Bottom deposits at Station 3 of fibrous material carried from an unidentified upstream source.

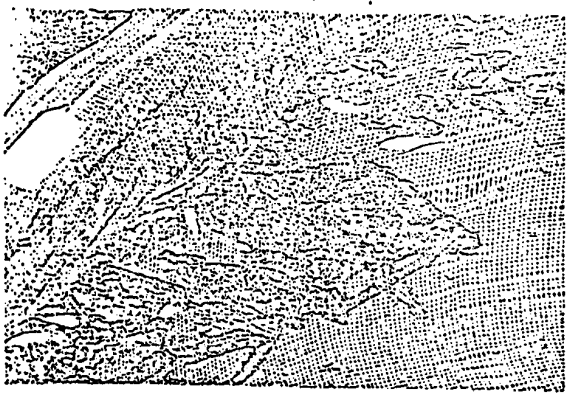


FIGURE 8. Common Shiners in seine net collected at Station 4.

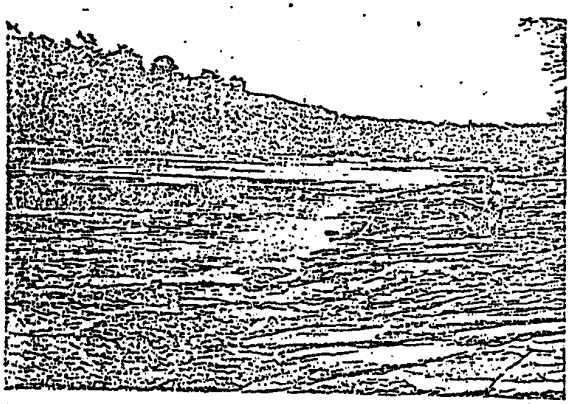


FIGURE 9. Downstream view from Station 4. Small stream flows in from the right.

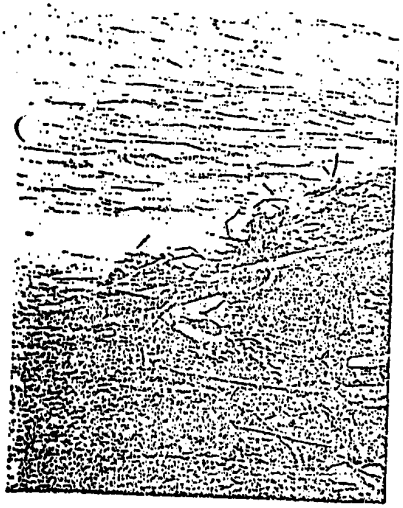


FIGURE 10.

Confluence of General Electric effluent stream and Hudson River. Note formation of oil on water slick.



FIGURE 11.

Water sampling at confluence of General Electric effluent and Hudson River. Note oil on water slick formed from effluent.

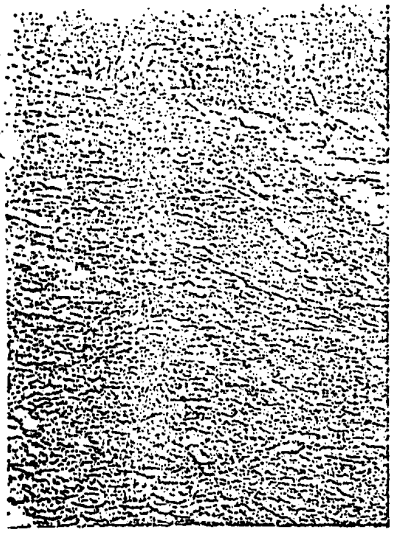


FIGURE 12.

Oil impregnated shale rubble river banks at outfall site.

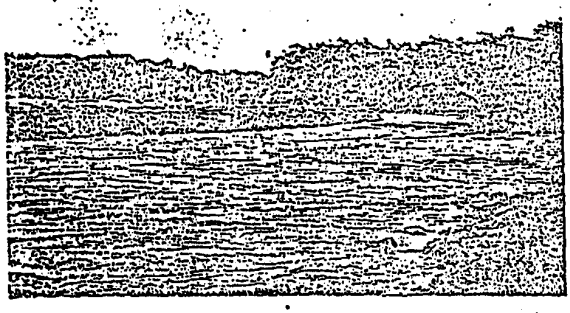


FIGURE 13. Sludge banks in background with newly cut river channel at Station 1 (outfall site).

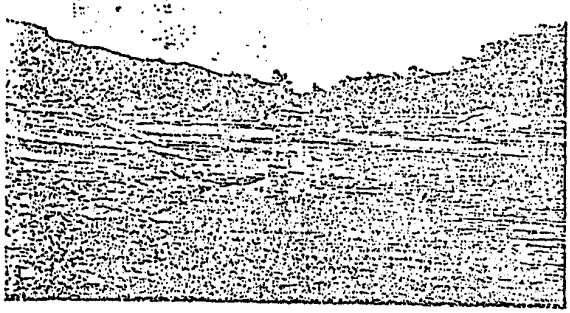


FIGURE 14. Upstream view from Station 4. Note tree in photo center growing on log-rock crib indicating level of water during impoundment.

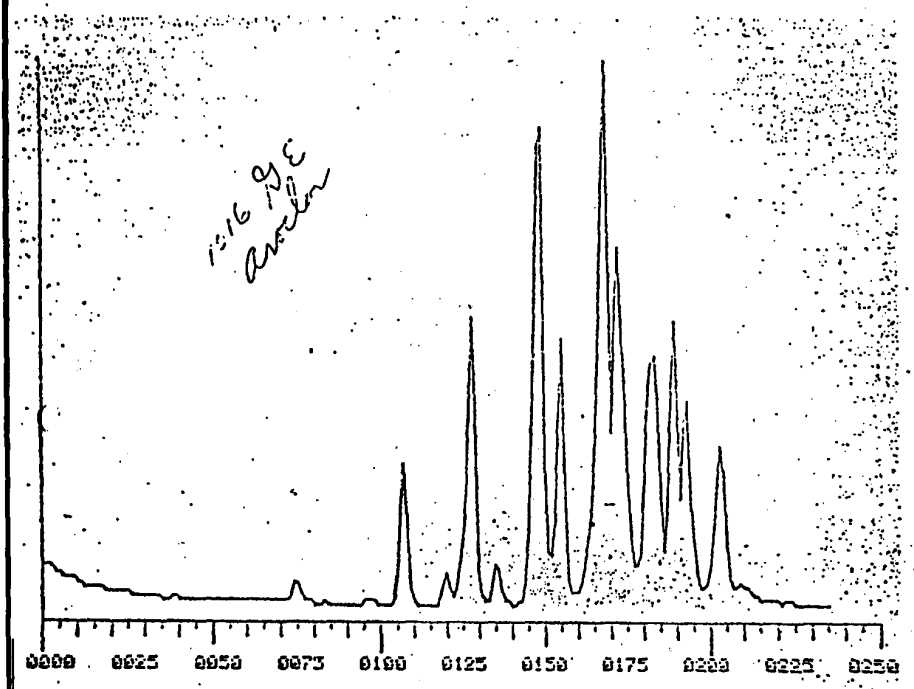


FIGURE 15. Gas chromatogram of Aroclor 1016 supplied by General Electric.

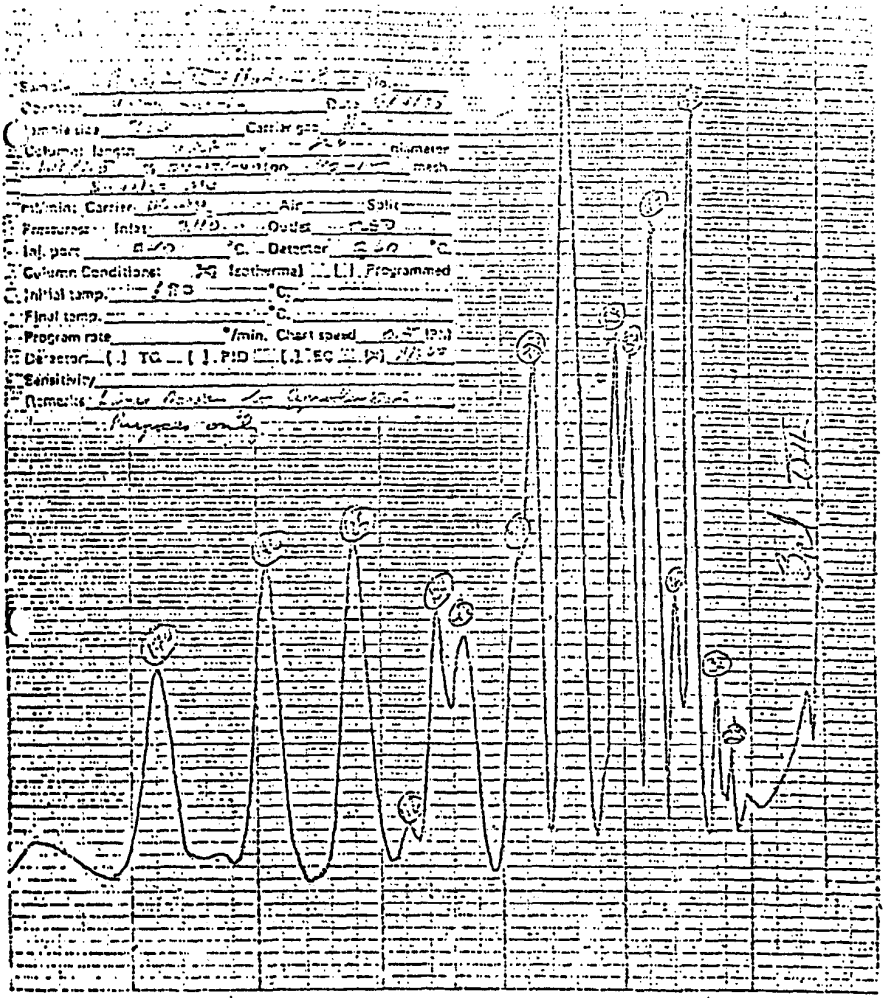


FIGURE 16. Chromatogram of a control station sample enumerating the relative retention times of the major components.

Sample: [illegible] No.

Operator: Veith Austin Date: 9/4/75

Sample size: 3µl Carrier gas: N_2

Column: length 6 ft x 1/8" diameter

19/15 [illegible] on 80-100 mesh

Supelco [illegible]

ml/min: Carrier [illegible] Air Spl

Pressures: Inlet 240 Outlet 240

Inj. port 240 °C. Detector 260 °C.

Column Conditions: [X] Isothermal [ ] Programmed

Initial temp. 180 °C.

Final temp. °C.

Program rate °/min. Chart speed 0.5 IPM

Detector: [ ] TC [ ] PID [ ] EC [X] Ni 63

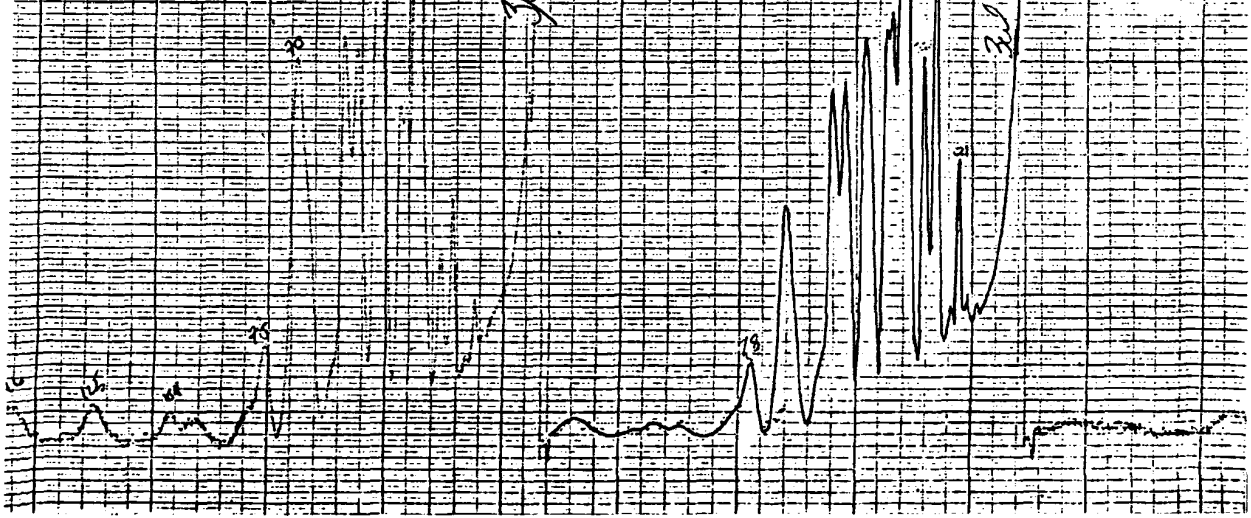
Sensitivity

Remarks

Veith

3µl II/25

3µl II/60



MONS 047554

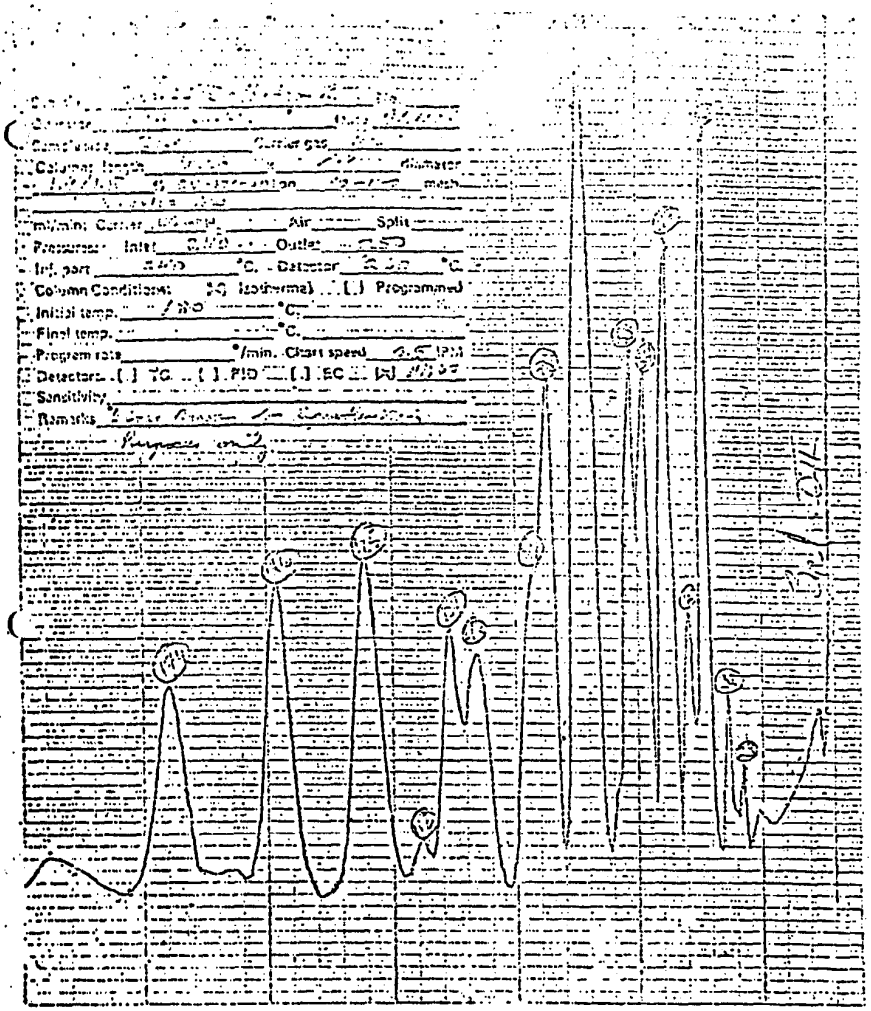


FIGURE 17. Chromatogram of the sample of bass collected below the discharge area at Station 3.

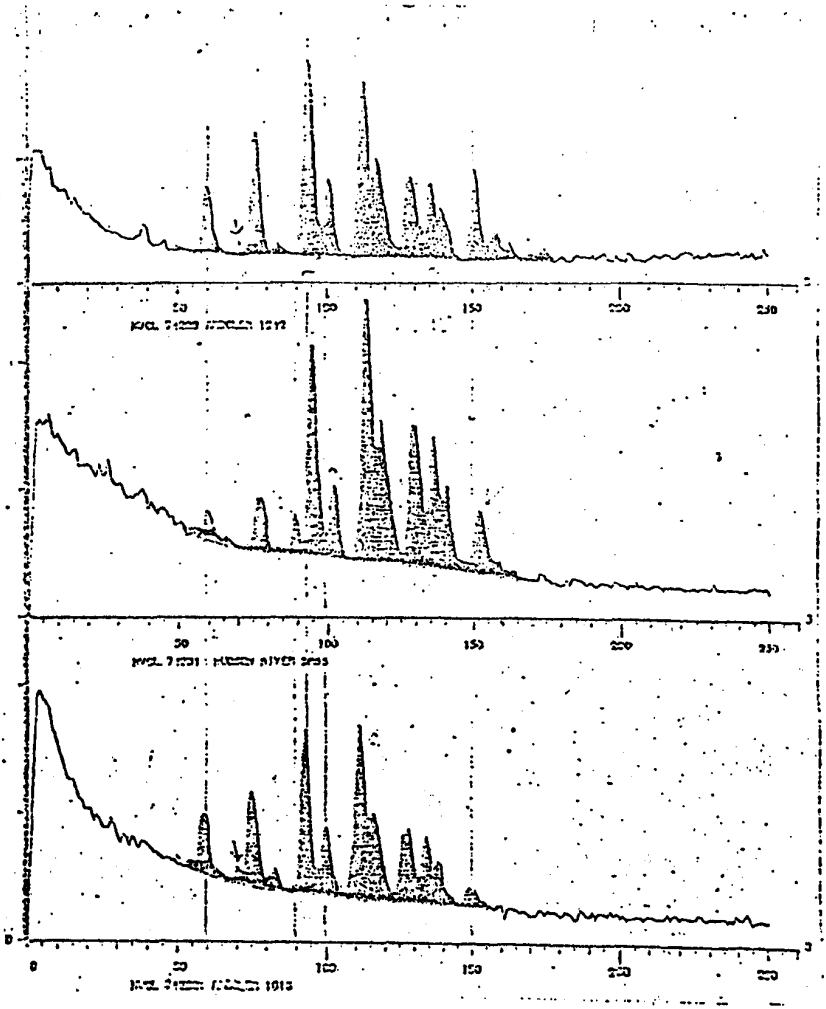


FIGURE 13. Comparison of the total ion current of the rock bass extract with those of Aroclor 1242 and Aroclor 1016.

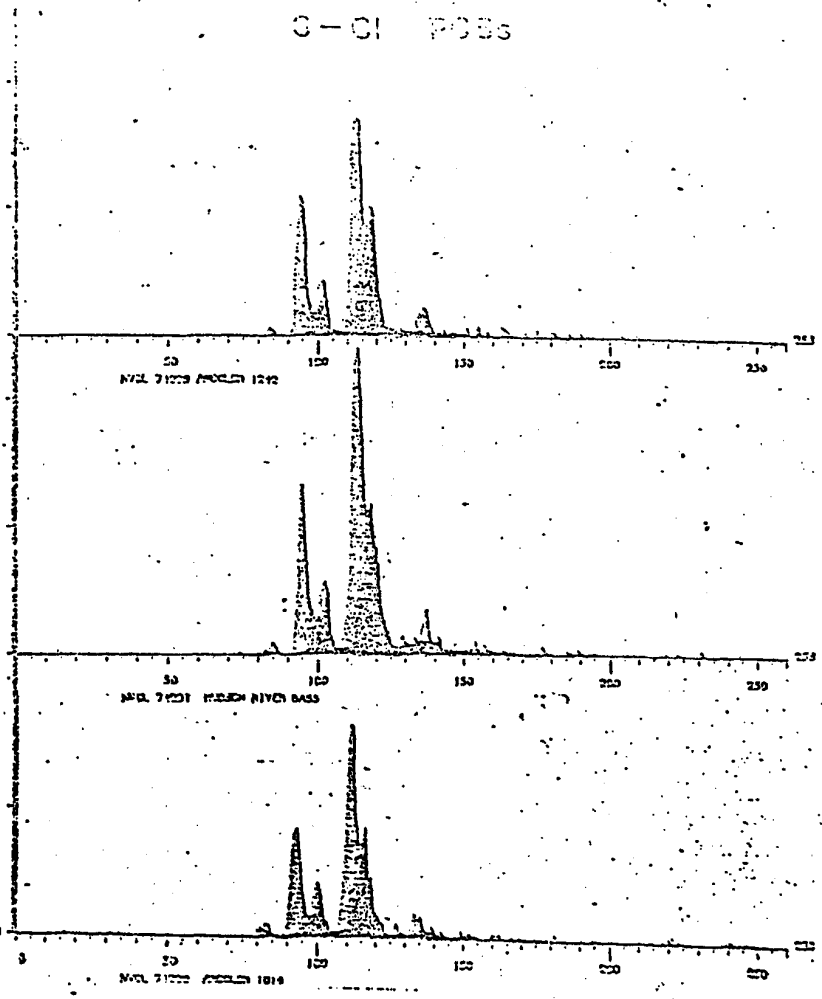
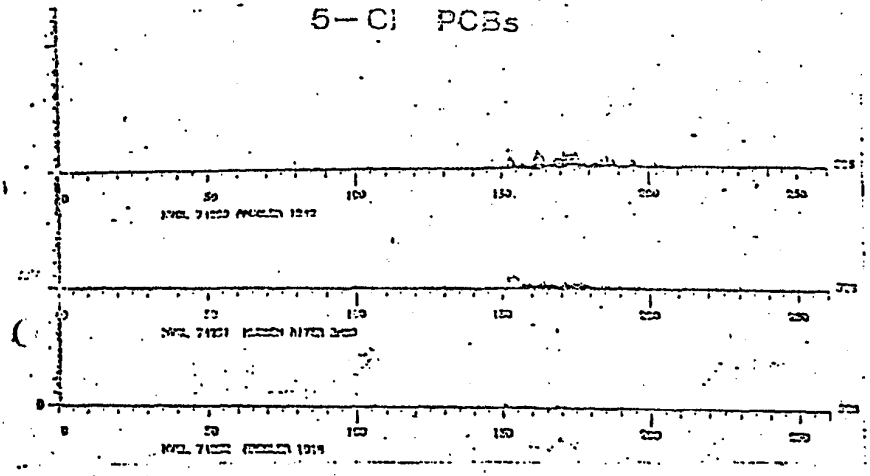


FIGURE 19. Comparison of the trichloro PCB mass chromatograms of the rock bass extract with those of Aroclor 1242 and Aroclor 1015.



GURE 20. Comparison of the pentachloro PCB's mass chromatograms of the rock bass extract with Aroclor 1242 and Aroclor 1016.

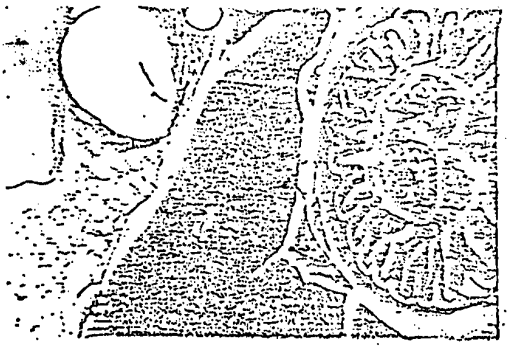


FIGURE 21. Cross section of liver tissue encompassing digestive tract from common shiner collected at Station 0 (control). Note normal tubulosinusoidal structure 63 X.

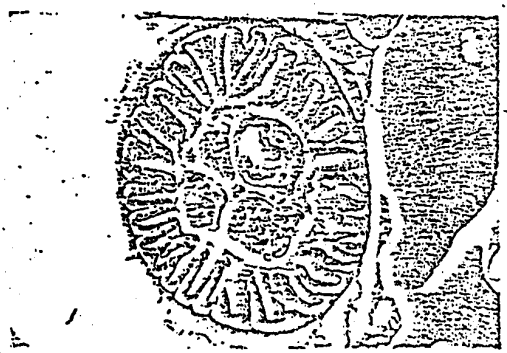


FIGURE 22. Cross section of digestive tract from common shiner collected at Station 0 (control) 63 X.

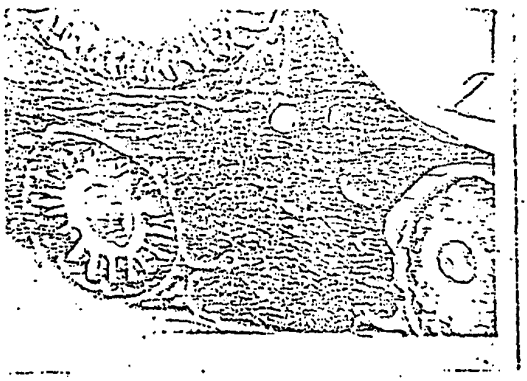


FIGURE 23. Cross section of liver tissue encompassing digestive tract from common shiner collected from Station 4. Note normal tubulosinusoidal structure. 63 X.

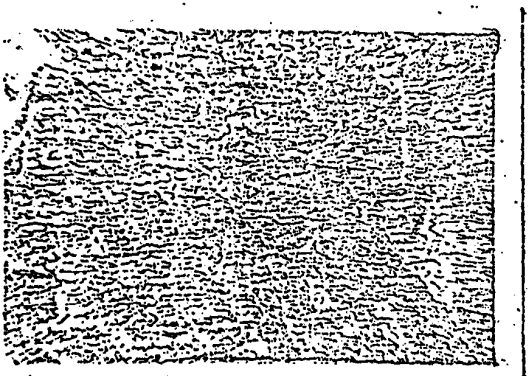


FIGURE 24. Cross section of liver tissue from common shiner collected at Station 4. Note normal tubulosinusoidal structure. 400 X.



FIGURE 25. Cross section of kidney from common shiner collected at Station 4. 63 X.



FIGURE 26. Cross section of gill branched chamber from common shiner collected at Station 4. Note normal gill filaments and lamellae. 63 X.



FIGURE 27. Cross section of kidney tissue from common shiner collected at Station 0 (control). Note normal structure of proximal tubules. 63 X.



FIGURE 28. Cross section of kidney tissue from common shiner collected at Station 0 (control). Note normal structure of tubules. 400 X.