ROUGH DRAFT

FF

Aroclor

AROCLOR - WILDLIFE PROBLEM

Pollution of our environment by chlorinated hydrocarbons (CHC) has long been a subject of great concern and much attention has been paid to the ecological factors introduced by the wide spread agricultural usage of these chemicals for pest control.

When environmental samples are examined by gas chromatography using electron capture detection, peaks corresponding to CHC pesticides such as lindane, dieldrin, DDT and their metabolities and breakdown products appear on the resultant chromatograms. In addition to these peaks residue analysts had been aware that it was not unusual for an addition^al series of as many as 10 peaks corresponding to unidentified compounds ~~to~~ also appear on these chromatograms. Little was known of the structure and origin of these compounds except that they possessed gas chromatographic properties similar to CHC pesticides.

In about 1965, Roburn and co-workers established that these unidentified materials were organo-chlorine in nature, with substantial chlorine content and consequently possessed electron capturing properties.

In December, 1966 Swedish researchers at the Univertsity of Stockholm (Jensen and Widmark) announced that they had succeeded in identifying a series of such peaks as polychlorinated biphenyls (PCB), specifically Cl_4 - Clg, using gas chromatography -mass spectrometric techniques.

Initially pesticide analysts were concerned only about the interference of these materials with the accurate measurement of pesticides such as DDT. However, it soon became evident that these materials were contributing to some of the long range ecological problems previously blamed totally on the chlorinated hydrocarbon pesticides. At this point ~~any number of~~ numerous^ workers began investigating the ecological effects and distribution of

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polychlorinate biphenyls. (See attached outline.)

It now becomes evident that the PCB problem and the CHC pesticide or DDT problem are nearly one and the same.

First, it can be said that there is no clear cut scientific evidence proving that the levels of CHC being found in our environment can cause a specific amount or kind of harm to human beings. The acute toxicity of these materials is quite clearly defined and documented and is really not the major concern. The major concern is the long range effects of these persistent materials, for it is known that these materials can ~~and do~~ accumulate in increasing quantities in adipose tissues. Moreover tests with experimental animals and experience with wild life in the field have shown that CHC can affect the reproductive systems of birds and that they are probably responsible for the severe decreases in the population of several species of birds of prey. The immediate extrapolation of these affects to other forms of life including human beings has been carried out orally but not scientifically. Here again, there is no experimental evidence to back up this extrapolation.

Based upon the data we and other outside workers have generated since our confirmation of the Swedish findings, analogous statements can be made about the higher chlorinated biphenyls (Cl_5 and above).

The information to date indicates that we have a global pollution problem, at the moment restricted to aquatic areas because of the transport and concentration of marine inhabitants mechanisms.

The levels of PCB reported are considerably higher in industrial areas than in the more remote areas so far examined. While the amounts being found (ppt, ppb, ppm) do not represent an acute toxicity problem they do represent long ~~range~~ term toxicity problems. Again, this is because of the persistent refractory nature of the higher chlorinated biphenyls (Cl_5 and above) combined with their proven ability to interfere with the reproductive abilities of

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birds and the oral extrapolation of this affect to other forms of life(with the exception of certain sensitive species).

Unfortunately the solution to the problem will initially involve our withdrawal of Aroclor 1254 and 1260 from the market place. Followed by a concerted effort to prove that Aroclor 1242 is biodegradable. If we can prove that Aroclor 1242 is biodegradable then with sufficient care the manufacture and use of this material can continue. The clearance of Aroclor 1242 will in turn clear materials such as 1221, 1232, etc. and possibly even Aroclor 1248.

In order to insure that there is no misunderstanding, it should be stressed that the probability of success of these studies is on the order of 75%. It could possibly be that the Cl_4 - Cl_9 PCB isomers being found are what is left after Aroclor 1242 has been biodegraded.

So far, the Aroclor 5400 series have not been reported as environmental contaminants.

E. S. Tucker

Not used by J. E. Grant per phone 11-11-69. Information Only.

10/10/69

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IDENTIFICATION TECHNIQUES

Analytically, the identification and quantitative estimation of PCB is not as clear cut as in the case of the CHC. Because of this, some comments about the detection methods employed are in order.

I. Electron Capture/Gas Chromatography
   A. Fairly specific but not an absolute identification technique.
   B. Extremely sensitive - detection limits in the nanogram range.

II. Microcoulometer/Gas Chromatography
   A. Specific for halogens
   B. Sensitivity - detection limits in the microgram range

III. Mass Spectrometry/Gas Chromatography
   A. Identification absolute
   B. Sensitivity - detection limits in the microgram range

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PCB Found Type	Amount	Anal. Tech.	Matrix	Geo. Location of Matrix	Who	Where	Date
PCB	80 ppm	GC/EC/MS	Sea Eagle	Sweden	Widmark	U.of Stockholm	12-29-66
PCB	-	GC/EC/MS	Fish	Sweden	Jensen/ Widmark	U.of Stockholm	12-29-66
PCB	-	GC/EC/MS	Sea Birds	Sweden	"	U.of STockholm	12-29-66
PCB	-	GC/EC/MS	Human Fat	Sweden	"	U.of Stockholm	12-29-69
PCB	13g/kg	EC/GC/MS	Sea Eagle	Stockholm	Jensen	Sweden	1-10-67
PCB	-	-	Fish,Birds, Seals,Air & Humans	England & Germany	Chem.Eng. News	-	-
PCB	-	Extraction, Liq-solid Chro.GC/GLC	Liver,fat & Eggs of birds, Seals & Fish	Britain	Holmes, Simmons, Tatton	Lab of Gov't Chemist,Londo	10-21-67
A-1254	89 ppm	Liquid-solid Chrom., GLC & MS	Chicken,eggs	Britain	"	"	11-2-67
PCB	-	-	Heron eggs	Tumby Woodside,Lincs. England	Richardson	Shell Chem. Sittingbourne Kent	11-6-67
PCB	<0.1 ppm	-	Human Fat	United Kgdm	"	"	11-6-67
PCB	10-20 ppm	-	Aquatic Birds	United Kgdm	"	"	11-6-67
PCB	-	Soxhlet extr., partition, Liq-solid ch., GLC	Seals & Porpoises	Scotland & Canada	Holden, Marsden	Nature, Vol. 216	12-30-67
A-1242	34-99 ppm	-	Gold Fish	-	Newell	Dept.of Agri. & Environmental Toxicology	5-3-68
Aroclor	-	GLC	Fish	Anniston,Ala.	Miller	Anniston,Ala.	12-31-68
A-1260	-	GC/EC/MS	Roach, Sandwich tern Eider	River Rhine Wadden Sea "	Koeman " "	Utrecht,Neth. " "	1968 " "
A-1254	ppm	EC/GC	Sea Birds	California	Risebrough	U. of Calif.	12-14-68
	"	"	Sea Bird Eggs	"	"	"	12-14-68

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PCB Compound Type	Amount	Anal. Tech.	Matrix	Geo. Location of Matrix	Who	Where	Date
A-1242	58 ppb	GC/EC	Water	Anniston (Snow Creek)	Tucker	R&D Labs	2-25-69
A-1242	0.20%	GC/EC	Sediment	Anniston (Snow Creek)	Tucker	R&D Labs	2-25-69
A-1242	1.64%	GC/EC	Sediment	Anniston (Snow Creek, 1 blk downstream)	Tucker	R&D Labs	2-25-69
Phenochlor	Fed-2000ppm	MS	Japanese Quail	Rhine River & Waden Sea	Koeman, DeVos	Zeist & Utrecht Netherlands	3-22-69
PCB	"low amounts"	Extraction GC/EC	Fresh Water & Sea Water	Britain	Holden	Pitlochry Fresh Water	4-28-69
A-1242	0.86%	EC/GC	Sludge	WGK	Tucker	R&D Labs	5-69
A-1242	10-100 ppb	EC/GC	Waste Water	WGK	Tucker	R&D Labs	5-69
A-1242	16.4ppm	EC/GC	Sediment	Mississippi River(300' downstream from WGK)	Tucker	R&D Labs	5-69
A-1242	1.2ppb	EC/GC	Waste Water	WGK (Prod. Dept.)	Tucker	R&D Labs	5-69
A-1242	26.5 ug/m^3 to 56.5 ug/m^3	EC/GC	Air Sples	Hartford, Conn.	L. Press	State Hlth Dept. of Conn.	5-7-69
PCB	to→100ppm	MS	Heron eggs & oil	England	Richardson	Shell Res. Sittingbourne	6-12-69
PCB (A-1254)	2 ppm	GC	Human Fat	Britain	Tatton	Monsanto, London	6-12-69
"	8 ppm	GC	Human Fat	America	Tatton	Monsanto, London	6-12-69
"	~200 ppm	GC	Heron Liver	Britain	Tatton	"	6-12-69
"	-	GC	Milk	Britain	Tatton	"	6-12-69
"	-	GC	Beef Fat	Britain	Tatton	"	6-12-69
PCB	-	GC	AQuatic Birds & Fish	Britain	Tatton	"	6-12-69

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PCB Type	Found Amount	Anal. Tech.	Matrix	No. Location of Matrix	Who	Where	Date
A-1242	746 ppm 0.477 ppm	EC/GC	Bluegill & Trout	Bio-Test	Tucker	R&D Labs	7-28-69
A-1242	0.078 ppm	EC/GC	Water	Bio-Test	Tucker	R&D Labs	7-28-69
A-1254	0.004 to 7.19ppm	EC/GC	Water	Bio-Test	Tucker	R&D Labs	7-28-69
A-1254	16.9 to 196.4ppm	EC/GC	Bluegill & Trout	Bio-Test	Tucker	R&D Labs	7-28-69
A-1260	5.62 to 14.5	EC/GC	Water	Bio-Test	Tucker	R&D Labs	7-28-69
A-1260	81.9 to 2052ppm	EC/GC	Bluegill & Trout	Bio-Test	Tucker	R&D Labs	7-28-69
A-1254	41 ppb	EC/GC & extraction	Environmental	Pensacola (Outfall)	Dukes	Bur. of Com'l Industries	8-8-69
A-1254	0.5 ppb	"	"	Hwy 90 Bridge	Dukes	US DEpt. of Interior	8-8-69
A-1254	12 ppm	"	Fish	Escambia Rvr	Dukes	"	8-8-69
A-1254	76 ppm	"	Flounder's Liver	Escambia Bay	Dukes	"	8-8-69
A-1254	274 ppm	"	Water	" "	Dukes	UofW Florida	8-13-69
A-1254	41 ppm	"	Water	Pensacola (Outfall)	Dukes	"	8-13-69
A-1254	0.5 ppm	"	Water	Pensacola (Hwy 90 Bridge)	Dukes	"	8-13-69
A-1254	12 ppm	"	Water	Pensacola (Mulat Bayou)	Dukes	"	8-13-69
A-1254	76 ppm	"	Fish	Pensacola (Escambia)	Dukes	"	8-13-69
A-1254	17.2 ppb	"	Water	Pensacola(Bur. of Fish)	Tucker	R&D Labs	8-20-69
A-1254	270 ppb	"	Water	"	Tucker	R&D Labs	8-20-69
A-1254	269 ppb	"	Water	"	Tucker	R&D Labs	8-20-69
A-1254	133 ppb	"	Fish	"	Tucker	R&D Labs	8-20-69
A-1254	1	GC/EC	Water	Lake Michigan	WARF	Wisconsin	9-11-69

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PCB Found Type	Amount	Anal. Tech.	Matrix	Geo. Location of Matrix	Who	Where	Date
A-1242	23.2 ppb	GC/EC	Water	Ann.(Snow Creek)	Tucker	R&D Labs	10-8-69
A-1242	2.36%	GC/EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1242	8.1 ppb	GC/EC	Water	Ann.(Choccolosso)	Tucker	R&D Labs	10-8-69
A-1242	5.8 ppb	GC/EC	Water	"	Tucker	R&D Labs	10-8-69
A-1242	78.0 ppb	GC-EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1248	3.62 ppm	GC/EC	Sediment	Ann.(Jackson Shoals)	Tucker	R&D Labs	10-8-69
A-1260	3.68 ppm	GC/EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1242	<2.0 ppb	GC/EC	Water	Ann.(City Treat)	Tucker	R&D Labs	10-8-69
A-1248	527 ppm	GC/EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1260	211 ppm	GC/EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1242	<2.0 ppb	GC/EC	Water	Ann.(Eureka Bridge)	Tucker	R&D Labs	10-8-69
A-1248	1.36 ppm	GC/EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1260	1.88 ppm	GC/EC	Sediment	"	Tucker	R&D Labs	10-8-69
A-1242	<2.0 ppb	GC/EC	Water	Ann.(Dust Scrub)	Tucker	R&D Labs	10-8-69
A-1254	4.7 ppb	GC/EC	Water	Pensacola (Escambia)	Tucker	R&D Labs	10-8-69
A-1254	74.8 ppb	GC/EC	Water	"(East Ditch)	Tucker	R&D Labs	10-8-69
A-1254	12.5 ppb	GC/EC	Water	"(Outfall)	Tucker	R&D Labs	10-8-69
A-1254	1.0 ppb	GC/EC	Water	"(Waste Water)	Tucker	R&D Labs	10-8-69
A-1254	1.4 ppb	GC/EC	Water	"	Tucker	R&D Labs	10-8-69
PCB(Cl_6)	900 ppm	Alumina Col. Separation	Heron egg	S.Lincolnshire	Abbott	Lab of Gov't Chemist	9-69
A-1242	1.0 ppb	EC/GC	Water	Pensacola Waste Waste 8-18-69	Tucker	R&D Labs	9-26-69
A-1242	1.4 ppb	EC/GC	Water	" 8-22-69	Tucker	R&D Labs	9-26-69
A-1242	4.7 ppb	EC/GC	Water	Escambia River	Tucker	R&D Labs	9-26-69
A-1242	74.8 ppb	EC/GC	Water	Pensacola (East Ditch)	Tucker	R&D Labs	9-26-69
A-1242	12.5 ppb	EC/GC	Water	"(Plant Outfall)	Tucker	R&D Labs	9-26-69
A-1242	470 ppb	GC/EC	Mud	Newport UK	Tucker	R&D Labs	10-8-69
A-1242	2068 ppb	GC/EC	Mud	"	Tucker	R&D Labs	10-8-69
A-1242	966 ppb	GC/EC	Mud	"	Tucker	R&D Labs	10-8-69
A-1242	665 ppb	GC/EC	Mud	"	Tucker	R&D Labs	10-8-69

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PCB Found Type	Amount	Anal. Tech.	Matrix	eo. Location of Matrix	Who	Where	Date
A-1242	0.05 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	1.40 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	0.86 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	0.67 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	1.87 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	6.00 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	0.17%	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	1.71 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	0.08 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-69
A-1242	0.53 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	0.20 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	0.45 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	0.67 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	0.04 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	5.88 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	0.03 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1242	15.3 ppm	GC/EC	Water	WGK	Tucker	R&D Labs	10-29-6
A-1254	<44 ppb	GC/EC/MS	Milk	Maryland Coop	Tucker	R&D Labs	10-30-6
A-1254	<3 ppb	GC/EC/MS	Milk	Maryland Coop	Tucker	R&D Labs	10-30-6
A-1254	<11 ppb	GC/EC/MS	Milk	Maryland Coop	Tucker	R&D Labs	10-30-6
A-1254	<1 ppb	GC/EC/MS	Milk	Maryland Coop	Tucker	R&D Labs	10-30-
A-1254	<171 ppb	GC/EC/MS	Milk	Maryland Coop	Tucker	R&D Labs	10-30-
A-1254	<1 ppb	GC/EC/MS	Water	Maryland Coop	Tucker	R&D Labs	10-30-
A-1254	<1 ppb	GC/EC/MS	Water	Maryland Coop	Tucker	R&D Labs	10-30-
A-1254	<1 ppb	GC/EC/MS	Water	Maryland Coop	Tucker	R&D Labs	10-30-
A-1254	<1 ppb	GC/EC/MS	Water	Maryland Coop	Tucker	R&D Labs	10-30-

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