Statistics
Special Study 71-24
Job No. 8505016

RESIDUE STUDY - AROCLOR IN WHITE LEGHORN CHICKENS

INTRODUCTION

Bio-Test Study #J7300 was set up to study toxicity, reproduction and residue when Aroclors were fed to white leghorn chickens. This report covers the statistical analysis of the data from the residue study.

SUMMARY

Chickens were fed 1, 10 and 100 ppm per day of Aroclors 1242, 1254 and 1260 over a two-year period. At the end of the period, some of the chickens were sacrificed and Aroclor residue determined on muscle, liver and fat tissues. The remainder of the chickens were taken off the Aroclor feed and put on PCB free diets for 30 days. During this period, the eggs produced each week were collected and at the end of the 30 day period, muscle, liver and fat tissues were obtained for analysis.

The data obtained are shown in Figure 1. Because of the large number of samples, only a balanced subset of the samples were actually tested. Originally, only female samples were tested, and data later obtained by spot-checking several male samples. Circled points are the data obtained subsequent to the initial analysis.

The chicken tissue data were fitted by a least squares method (multiple regression) to the following model:

Log PPM Aroclor Found = C_0 + C_1 (if recovery) + C_2 (if muscle) + C_3 (if liver) + C_4 (if fat) + C_5 (per cent chlorine) + C_6 (log feed level) + C_7 (if male) + C_8 (recovery if muscle) + C_9 (recovery if liver) + C_{10} (recovery if fat) + C_{11} (per cent chlorine if recovery) + C_{12} (feed level if recovery) + C_{13} (per cent chlorine if muscle) + C_{14} (feed level if muscle) + C_{15} (per cent chlorine if liver) + C_{16} (feed level if liver) + C_{17} (per cent chlorine if fat) + C_{18} (feed level if fat + C_{19} (per cent chlorine) X (feed level).

The data from the egg samples were fitted to this model:

Log PPM Aroclor found = C_0 + C_1 (recovery time) + C_2 (log feed level) + C_3 (per cent chlorine) + C_4 (recovery time) X (log feed level) + C_5 (recovery time) X (per cent chlorine) + C_6 (log feed level) X (per cent chlorine) + C_7 (recovery time) X (log feed level) X (per cent chlorine).

CONCLUSIONS

1. For the chicken tissue equation, the following coefficients were found to be statistically significant: (95% level) C_0, C_5, C_6, C_7, C_8, C_{15} and C_{16}.

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2. The following coefficients improved the fit but were not in themselves statistically significant: C_{10}, C_{11}, C_{12}, C_{14} and C_{18}.

3. For the egg data, all the coefficients in the model were found to be statistically significant (95% level) except for C_6.

4. The 95% confidence limits of prediction were the same for both equations. The lower limit is 0.45 times the predicted value; the upper limit is 2.24 times the predicted value. These limits are compatible with those found on albino rat and beagle dog studies.

DISCUSSION

Figure 2 shows the predicted Aroclor residues based on the two equations developed. Figure 3 shows calculated values for 1242 at levels of Aroclor in feed >10 ppm. Figure 4 gives the calculated coefficients and their t values for both equations. Figures 5 and 6 are the actual and predicted results for the data used to develop the equations.

At low feed levels, the amount of PCB's found in the liver is lower than for the other chicken tissues. At higher feed levels the liver results tend to be equal to or higher than the fat samples, but muscle samples contain the most PCB. The difference between the final sacrifice samples and the recovery samples is less for the liver than for the other tissues especially at the highest feed level.

During the recovery period, the egg samples gradually decreased in PCB content. The most rapid decrease occurred in 1242, with correspondingly slower decreases in 1254 and 1260.

db

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FIGURE 1

PPM Lipid Wt Basis

ACTUAL DATA

Biotest Study # J7300

Toxicity, Reproduction and Residue Study on Aroclor in White Leghorn Chickens

		1) Final Sacrifice						30 Day Chick Sacrifice			1st wk.	2nd wk.	3rd wk.	4th wk.	1st wk.	2nd wk.	3rd wk.	4th wk.	1st wk.	2nd wk.	3rd wk.	4th wk.	2) Recovery Sacrifice					
		1ppm		10ppm		100ppm		1ppm	10ppm	100ppm	1ppm				10ppm				100ppm				1ppm		10ppm		100ppm	
		♂	♀	♂	♀	♂	♀	Composite ♂♀	Composite ♂♀	Composite ♂♀	Recovery Period												♂	♀	♂	♀	♂	♀
Aroclor 1242	Muscle		13				901	9	12															8		30		639
	Liver				52			14	12															10		28		1584
	Fat	26	22			2460	1312																	4		–		9
	Egg			37	58 / 27	472									33	5	5		383	361	249	368						
Aroclor 1254	Muscle			517	245			2																		61		
	Liver		18				1475	4																7				1529
	Fat			892	199																					73		
	Egg	10				1410						14	6	5						1324	626	832						
Aroclor 1260	Muscle		40				6025	5	125															26				1710
	Liver				86			6	6																	109		
	Fat	183	17			7550	1308																	21				2172
	Egg	12		146							13	7			135	71												
Control	Muscle		10	*				16	*						*									4	*			
	Liver		5					12																5				
	Fat		0.4																					3				
	Egg																											

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* Common control
1) Between 22nd and 26th week.
2) Between 26th and 30th week.

FINAL VS RECOVERY 0,1
TISSUE TYPE 0,1; 0,1; 0,1.
MATERIAL TYPE – % Cl.
FEED LEVEL 106 PPM

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Figure 2

Predicted PCB Found

(ppm Lipid Wt. Basis)

Biotest Study # J73-00

Toxicity, Reproduction and Residue Study of Aroclor in White Leghorn Chickens

		1) Final Sacrifice						30 Day Chick Sacrifice			1st wk.	2nd wk.	3rd wk.	4th wk.	1st wk.	2nd wk.	3rd wk.	4th wk.	1st wk.	2nd wk.	3rd wk.	4th wk.	2) Recovery Sacrifice					
		1 ppm		10 ppm		100 ppm		1 ppm	10 ppm	100 ppm	1 ppm				10 ppm				100 ppm				1 ppm		10 ppm		100 ppm	
		♂	♀	♂	♀	♂	♀	Composite ♂ ♀	Composite ♂ ♀	Composite ♂ ♀	Recovery Period												♂	♀	♂	♀	♂	♀
Aroclor 1242	Muscle	52	16	368	103	3989	1258																16	5	114	36	1947	600
	Liver	26	8	189	56	3633	1181																19	6	133	41	3872	1193
	Fat	52	16	360	109	2918	899																19	6	114	36	1390	428
	Egg	3		40		498					1.5	0.9	0.6	0.4	25	16	10	7	424	362	308	263						
Aroclor 1254	Muscle	103	32	602	186	7799	2404																30	9	190	59	3159	981
	Liver	38	12	268	82	5670	1747																27	8	176	55	5152	1603
	Fat	103	32	583	180	5247	1614																30	9	190	59	2344	728
	Egg	7		92		1141					6	5	4	3	60	66	54	44	1007	881	775	681						
Aroclor 1260	Muscle	126	39	808	249	9825	3028																35	11	342	75	4031	1252
	Liver	47	15	324	100	6892	2124																30	9	203	63	5909	1835
	Fat	126	39	779	240	7024	2165																35	11	245	76	2998	931
	Egg	11		140		1728					12	13	14	15	137	135	133	131	1543	1378	1231	1099						
Control	Muscle			*					*		↖	↑	↑	7	*										*			
	Liver																											
	Fat																											
	Egg																											

* Common control

1) Between 22nd and 26th week.

2) Between 26th and 30th week.

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WHITE LEGHORN CHICKENS
FINAL SACRIFICE
PREDICTED PCB FOUND
(PPM Lipid Wt Basis)
AROCLOR 1242

	2PPM		4PPM		8PPM	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
MUSCLE	90	28	157	48	278	86
LIVER	46	14	82	25	148	46
FAT	90	28	155	48	270	83

24/MONTH

RECOVERY

	2PPM		4PPM		8PPM	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
MUSCLE	29	9	55	17	98	30
LIVER	33	10	59	18	108	33
FAT	29	9	55	17	98	30

FIGURE 3

CALCULATED RESULTS FOR NARROWER FEED RANGE

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FIGURE 4

COEFFICIENTS OF PREDICTING EQUATIONS
LOG PPM FOUND

CHICKEN TISSUES

TERM	COEFFICIENT	t VALUE
CONSTANT	0.31438	
PERCENT CHLORINE	0.02119	5.5401
LOG FEED LEVEL	0.77561	8.9829
IF MALE	0.51118	5.4423
RECOVERY IF MUSCLE	−0.32540	2.3040
RECOVERY IF FAT	−0.30835	1.9938
%CHLORINE (RECOVERY)	−0.00346	1.4920
FEED LEVEL (RECOVERY)	0.00150	.0557
FEED LEVEL IF MUSCLE	0.00344	1.7661
%CHLORINE IF LIVER	−0.00703	3.2098
FEED LEVEL IF LIVER	0.00612	2.9074
FEED LEVEL IF FAT	0.00198	1.1049

RESIDUAL STANDARD DEVIATION = 0.17554

% OF VARIANCE EXPLAINED = 97.59%

EGGS

TERM	COEFFICIENT	t VALUE
CONSTANT	−0.74777	
RECOVERY TIME (WEEKS)	−1.17943	2.4446
LOG FEED LEVEL	1.09205	12.3933
PERCENT CHLORINE	0.03002	3.2198
RECOVERY TIME X LOG FEED LEVEL	0.53156	2.1426
RECOVERY TIME X PERCENT CHLORINE	0.02022	2.2705
RECOVERY TIME X LOG FEED LEVEL X %CHLORINE	−0.00955	2.0582

RESIDUAL STANDARD DEVIATION = 0.17466

% OF VARIANCE EXPLAINED = 97.59%

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FIGURE 5
CHICKEN STUDY - PPM FOUND
RESIDUALS FROM REGRESSION EQUATION
(VALUES ≥ 1000 DIVIDED BY 10)

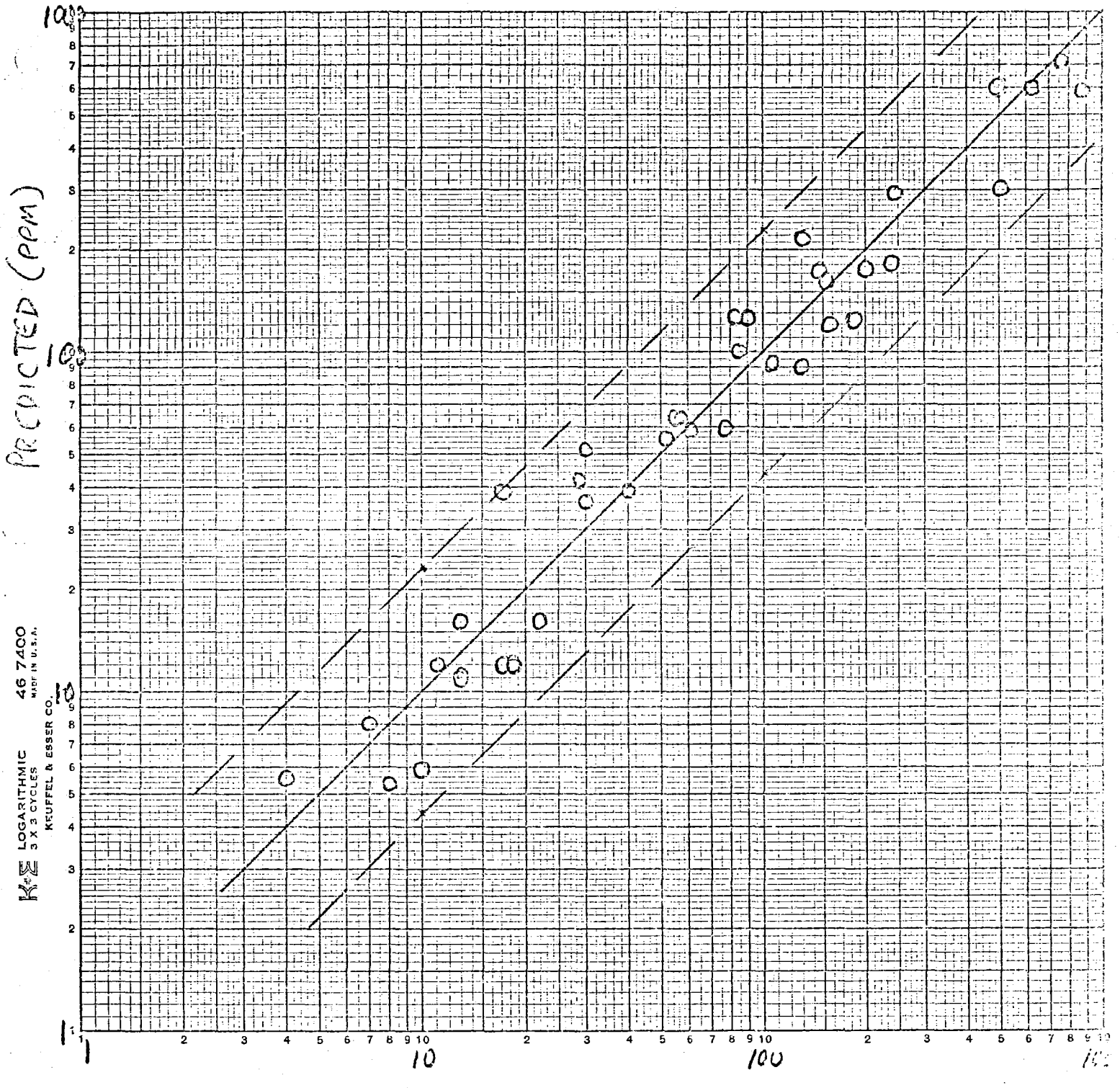

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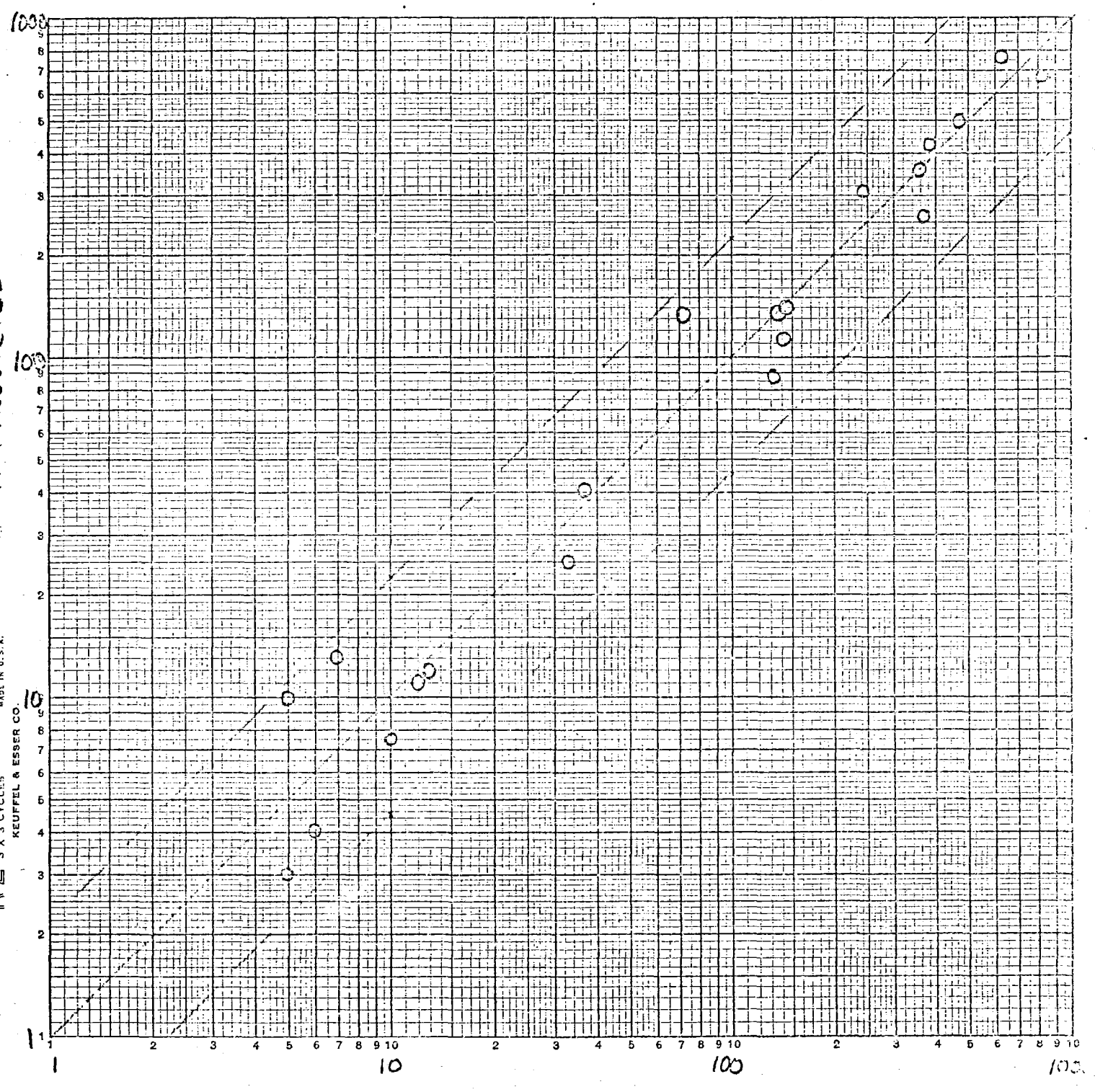
FIGURE 6

EGG DATA - PPM FOUND

RESIDUALS FROM REGRESSION EQUATION

VALUES > 1000 DIVIDED BY 10



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