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The Effects of Polychlorinated Biphenyls (PCBs) on Chick Embryos

BERNARD McFADDEN

Mr. McFadden is science chairman at W. T. Clarke High School, Westbury, New York. The research and experiments for this project were carried out by Mitchell Stein, a sophomore at the school.

Within the last few years, polychlorinated biphenyls (PCBs) have been identified as chemical pollutants, harmful to birds, fish, and mammals. PCBs are organic chlorine compounds chemically similar to DDT. They are used in the electrical industry as insulators, in the hydraulics industry for high temperature lubricants, and in the plastics and paint industries for their plasticizing properties. When PCBs are present in the food chain and the compound is ingested, the chemicals become concentrated in the fatty tissue of animals. If the accumulation of PCBs becomes great enough, it can be lethal to some fish and aquatic invertebrates.

Recently, deformities in tern chicks were noted on Great Gull Island in Long Island Sound where a high concentration of PCBs exists. A student at W. T. Clarke High School decided to add to the data accumulated on PCBs by testing their effects on white leghorn chicken eggs. He hypothesized that the effects of PCBs on the Long Island tern chicks could be duplicated in the laboratory by injecting PCBs into fertile chick eggs. He also hypothesized that the fatality rate and degree of malformation in the chick embryo would be a function of the percent of chlorine content in the PCBs.

Three different types of PCBs (Aroclor 1221, 1242, and 1254) were obtained from the manufacturer. The last two digits of the identification number indicate the weight percentage of chlorine in the product. Thus, Aroclor 1221 has 21 percent chlorine, 1242 has 42 percent, and 1254 has 54 percent.

Forty-eight freshly fertilized white leghorn chicken eggs were purchased. Holes were drilled in the egg shells with a dental drill. A hypodermic syringe was used to inject the solution into the eggs. Sterile procedures were observed at all times.

Corn oil was used to dilute the PCBs because it is nontoxic and PCBs are soluble in it. The student measured out 200 mg, 300 mg, and 400 mg of each Aroclor PCB and added these quantities, respectively, to vials containing 10 cc of corn oil. Thus, concentrations of 10 mg, 15 mg, and 20 mg per ½ cc were achieved. Nine solutions were prepared and administered to 39 chick eggs. The remaining nine eggs were used as controls.

After 17 days of incubation, the eggs were opened and the embryos detached from the amniotic sacs. Each embryo was examined and preserved. The results of the experiment indicate that PCBs with chlorine levels at 42 percent or greater, in doses larger than 10 mg/0.5 cc, are fatal to chick embryos. PCBs with a 21 percent chlorine content, in doses of 10 mg/0.5 cc, result in smaller embryos than normal, with size decreasing as the dosage is increased. Malformation of the embryo also appears with larger doses.

PCBs represent examples of chemicals introduced by industry to satisfy a technical need that have now been discovered to be major pollutants of the environment. The experiments performed by the student on chick embryos indicate that PCBs have a detrimental effect on the possibilities for survival of certain species of aquatic predatory birds. □

(Right) Mitchell injecting chick egg with PCB solution. (Below) Explaining results to a fellow student.