Pandora and the Storage Tank

BY KEVIN P. SHEA AND BERT LINDLER

A modern epidemic

IN THE SPRING of 1971, a mysterious and deadly disease began killing horses at three riding stables in central and eastern Missouri. Before the epidemic was over, more than 60 horses died, one six-year-old child was hospitalized and several other persons became ill, and dozens of pet dogs and cats, as well as hundreds of birds, were killed.

After three years of investigation, the cause of the epidemic was finally traced to a tank of industrial waste residues heavily contaminated with one of the most toxic organic chemicals known — 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The poison, a by-product in the manufacture of a few industrial and agricultural chemicals, is the same contaminant which, in the early 1970s, was found in 2,4,5-T, one of the herbicides widely used in Vietnam as part of the military defoliation program.

TCDD, often referred to as dioxin, is an enormously toxic chemical. (See "The Hazards of Impurities," *Environment*, June 1973.) Among the symptoms produced by TCDD in exposed animals are liver and blood vessel damage, chloracne (a skin disease), gastric ulcers, and loss of appetite. The chemical is also a powerful inducer of birth defects in animals at exposure levels in the parts-per-billion range. In exposed individuals, TCDD is excreted very slowly and may accumulate in the body. It is also a stable compound in the environment, having a half-life in soil of about one year.[1] An additional property of TCDD, and one that played an important role in the Missouri incident, is the ease with which TCDD is absorbed through the skin. Altogether, TCDD is a highly dangerous compound that requires the utmost care in handling, storage, and disposal.

The epidemic in Missouri, the first of its kind involving the improper disposal of waste residues containing TCDD, almost took the life of a small child. The events leading up to the incident provide a classic example of the costly and sometimes tragic results of neglect, ignorance, and the lack of effective regulations for the disposal of hazardous waste residues.

MONS 206423

BERT LINDLER is a technical writer for the U S Forest Service in Missoula, Montana.

The plant which produced the toxic wastes is located near the small southeastern Missouri town of Verona. In the late 1960s, the plant, operated by the Hoffman-Taff Company, manufactured a variety of chemicals including trichlorophenol, the starting material for both hexachlorophene and 2,4,5-T production. In 1970, the company was purchased by Syntex-Agribusiness, which in turn executed a contract with the Northeast Pharmaceutical and Chemical Corporation (NEPACCO) for the latter corporation to produce trichlorophenol at the Verona plant. Production of this chemical began in April 1970 in that section of the Verona plant leased by NEPACCO.

As a result of trichlorophenol production at the Verona plant, it is estimated that 40 to 50 gallons of "still residues" were produced each week. The still residues, a thick, black, tar-like substance containing the concentrated TCDD contaminant, were routinely stored in tank G-7, a 7,500 gallon-capacity storage tank at the Verona site, where they were allowed to accumulate until the tank was filled and disposal of some of the material became necessary.

Removing the Wastes

The first NEPACCO disposal contract went to Rollins Environmental Service Company of Baton Rouge, Louisiana. The Rollins company specializes in disposal, by incineration, of highly chlorinated industrial wastes. The company received only one shipment of still residues from the Verona plant, a 5,000-gallon truckload shipped in October 1970.

Other wastes from the Verona plant, described as "contaminated water," were transported from the plant during the winter months of 1971-72 at the rate of about 6,000 gallons per day for a period of about 90 days. These wastes were taken to the Water and Waste Management School at Neosho, Missouri, after a controversy with Syntex-Agribusiness over on-site disposal in a settling pond forced NEPACCO to contract for disposal with the waste management school. It is not certain if the contaminated water contained traces of TCDD.

Perhaps for the sake of economy, NEPACCO's next disposal contract went to the Independent Petrochemical Company, which subcontracted with the Bliss Salvage Oil Company to haul away the still residues. The Bliss company collects, stores, and resells waste oils from a large variety of sources. Most of the still residues from the Verona plant were hauled to St. Louis and placed in a large tank with waste oils from other sources. During storage, the heavier fractions of the wastes settle to the bottom of the storage tank, forming a thick sludge. When oil is sold for re-refining, or for use as a fuel oil, it is drawn off the top of the tank while the sludge collects at the bottom.

Between February and October 1971, the Bliss company hauled six truckloads of still residues, totaling 16,000 gallons, from the Verona plant. On May 25, 2,000 gallons of the still residues were sprayed at the stable at which the worst damage was later found.

Signs of Trouble

The first indication that something was wrong occurred on May 30. While sweeping the stable for that day's horse show, the stable owners noticed hundreds of dead birds on the floor of the arena barn. Spectators noticed an unusual absence of flies and other insects during the show, and, on the same day, two horses kept in stalls near the arena became ill and two kittens were found dead. On June 1, three more horses became ill, and during the next two weeks all the remaining cats and dogs at the stable became ill and died.

During the last two weeks in June, twelve more horses became ill. Their symptoms included weight loss, bleeding at the mouth and nose, diarrhea, bloody urine, and abdominal colic. Six months later, in January 1972, six horses not previously kept in the sprayed area were brought into the barn closest to the arena where they were exercised daily. On its sixth day in the barn, one of the horses developed hind-limb weakness. It was removed to another barn but eventually developed severe symptoms and died. Again, in January, the owners moved a newly purchased stallion into the barn, but this animal also developed symptoms of illness and was moved to another area.

While some of the horses became ill and died, many that survived were later unable to breed. There were 26 known cases of spontaneous abortion, six horses gave birth to deformed foals, three foals died at birth, and fifteen foals died within four months of birth. Altogether, of a total of 41 breedings in 1971, only one foal survived.

The most serious incidents, however, occurred in August 1971, about three months after the arena had been sprayed. The co-owners of the stable reported that they suffered headaches and nausea. The ten-year-old daughter of one of the co-owners suffered the same symptoms. The daughter of the other co-owner, a six-year old who had played on the arena floor almost daily throughout the summer, was more seriously ill. In early August, she experienced occasional attacks of diarrhea and bloody urine. On August 17, she complained of severe and prolonged headache, and, on August 21, she developed severe bladder pain, fever, sweating, chills, jaundice, and gastrointestinal symptoms. She was treated by her physician, but when no improvement was noticed she was admitted to St. Louis Children's Hospital, where she was treated for hemorrhaging of the bladder and inflammation of the kidneys.

Investigation Begins

On August 23, physicians at Children's Hospital contacted the Center for Disease Control (CDC) in Atlanta, Georgia, and suggested that both the child's illness and the animal deaths at the stable might have been caused by a common toxic agent. The CDC, part of the U S Department of Health, Education and Welfare, accepted the invitation to cooperate in an investigation of the incidents and, one year later, published an interim report[2] in which the investigators suggested various toxins which might have been involved in the poisonings. According to the report, one of these substances, polychlorinated biphenyls (PCBs), was detected in soil samples taken from the arena floor. Elevated levels of PCBs, however, were not found in the patient. At that time, the CDC felt that the toxin involved was probably a type of or-

The poison, a by-product in the manufacture of a few industrial and agricultural chemicals, is the same contaminant which, in the early 1970s, was found in 2, 4, 5-T . . . .

MONS 206424

Of the six truckloads of poisonous residues, totaling nearly 16,000 gallons, that left the Verona plant between February and October 1971, some 10,000 gallons are still not completely accounted for.

ganophosphate, since a phosphorus-containing compound had been found in blood samples from affected horses. It took almost another year of laboratory analysis to determine that the poison was actually TCDD. Their analysis included measurement of TCDD levels in arena soil samples. A concentration of 32 to 33 parts per million (ppm) of TCDD was found. In another test, involving laboratory animals, an extract of arena soil containing 61 ppm TCDD was applied in small doses to the inner ears of four rabbits. After three succeeding days of application, two of the rabbits died.

When it became apparent that the dust-control spraying was the cause of the animal deaths, the soil in three arenas was removed and replaced with uncontaminated fill. The soil removed from one arena was then dumped into a sanitary landfill, and the soil from another was used to fill gullies and a hole in a yard near Fenton, Missouri. The soil from the third arena was dumped into a highway construction project and covered. The last horse affected by the TCDD exposure died in January 1974, and none of the stables have since experienced any related problems.

More Questions

Although this particular episode is over and its history is known in some detail, a number of unanswered questions remain. The most important question is, What happened to the contaminated still residues that were shipped from the NEPACCO operation at the Verona plant to the Bliss company holding tanks in St. Louis? The full answer is complicated, but at least part of one shipment may be accounted for by yet another poisoning episode in another part of Missouri.

Records show that on May 20, 1971, the date of one of the pickups of still residues by the Bliss company, the Missouri Department of Motor Vehicles issued a citation at one of its weighing stations to a 1966 Chevrolet truck because it was 950 pounds overweight. In Missouri, trucks carrying excess weight are allowed to leave the weighing station after being issued a citation if they are unable to unload enough cargo to meet state regulations. Under these circumstances, drivers risk another citation if they should encounter another weighing station.

The citation issued on May 20 does, in fact, note that the driver left without lightening his load. But, instead of chancing another citation, he pulled off the highway near St. James, Missouri, and drove to the farm of his employer, Russell Bliss. There, he opened the spigot of the 3,000-gallon-capacity truck and drove down a short dirt road, spewing the excess contaminated still residues along the way. Several days later, about 70 chickens and a dog belonging to Bliss's caretaker died, but Bliss insists that the poisonous residues were not the cause of the animals' deaths.

Of the six truckloads of poisonous residues, totaling nearly 16,000 gallons,[1] that left the Verona plant between February and October 1971, some 10,000 gallons are still not completely accounted for. Those residues not sprayed on roads or in horse arenas were shipped to the Bliss storage tanks in St. Louis. The Bliss company picks up used oil from about 1,800 different sources, including service stations, trucking companies, airports, and at least one transformer company. Its daily collection of waste oil totals 10,000 to 15,000 gallons. On some occasions, the company hauls waste oil from its source directly to a waste oil reprocessor, but more often the waste oil is shipped to storage tank B-1 in St. Louis where it is kept until it can be sold to a reprocessor.

One of Bliss's major reprocessing customers is the M. T. Richards Company of Crossfield, Illinois. The Richards company routinely picks up oil from tank B-1 in a 6,000-gallon-capacity truck and transfers it to its own property for storage in one of four 1,500-barrel-capacity tanks until the oil is processed. After processing, the Richards company sells the reclaimed waste oil to a number of industries as low-grade fuel oil. The remaining sludge is used during the summer months to oil roads within a two-mile radius of Crossfield. CDC officials analyzed samples from the Illinois roads but did not detect any traces of TCDD. The exact amount of poisonous residues purchased by Richards is not clear but it could account for a large part of the material brought to St. Louis from Verona.

The federal Environmental Protection Agency has also become involved and has advised the state that even land-based incineration may not be the best method of disposal.

During the CDC's investigation another question arose involving still another toxic chlorinated hydrocarbon. In interviews with the CDC investigators, Russell Bliss stated that each year he picked up about 10,000 gallons of PCB-containing wastes from a transformer company. Bliss said that he did not store them in his tanks but sold them directly from his collection trucks because they bring a higher price than motor oil. The unregulated sale of PCBs is a cause for concern because there have been recorded outbreaks of PCB poisoning in humans resulting from occupational exposures to the PCBs and from the ingestion of PCB-contaminated cooking oil (see "PCB," *Environment*, November 1973). Since symptoms of PCB poisoning are somewhat similar to those of TCDD poisoning—chloracne, liver damage, and kidney malfunctions—the CDC investigators decided to test arena soil samples for PCB. The results showed very high residues of PCBs (338 ppm), but, as noted earlier, elevated PCB levels were not found in persons exposed to the arena soil. PCBs are not nearly as toxic as TCDD, but nevertheless this discovery points to another example of the way in which toxic industrial wastes can infect the environment.

While the CDC's investigation has accounted for nearly all of the contaminated still residues, 4,300 gallons still remain in the Verona storage tank. How this material will be disposed of is not certain, but, for the present, a concrete-block dike has been constructed around the tank to prevent trucks from running into it and to contain the residues in the event of a spill. The tank valve is locked and the area is sealed off with a heavy chain.

The current owner of the tank, Syntex-Agribusiness, is not happy about being in charge of the deadly poison and claims the disposal problem belongs to NEPACCO. The company that produced the material in 1971 but

MONS 206425

which is now out of business. While Syntex is taking responsibility for the disposal of the wastes, company officials do not feel that they should be liable for the damage caused in the past or for any accidents.[3] State health authorities are unable to act in this case since there is no state law that would enable them to order the material destroyed. Together, Syntex and state health authorities are trying to determine the best method for disposal of the wastes, whether by incineration, chemical degradation, or a process called chlorinolysis.

The federal Environmental Protection Agency (EPA) has also become involved and has advised the state that even land-based incineration may not be the best method of disposal. The EPA recently refused to allow incineration of 2.3 million gallons of military 2,4,5-T contaminated with about 2.0 ppm TCDD, a much lower level of contamination than the 300 ppm TCDD in the Verona residues. The state has also looked into the possibility of burning the residues in the ocean-going incinerator ship *Vulcan*. European industrial wastes have been burned on that ship which cruises in the North Sea.

But even after disposal of the residues, there will be the problem of what to do with the storage tank itself. In a letter to H. Denny Donnell of the Missouri Division of Health, Clark W. Heath of the CDC recommended sealing the tank, labeling it to identify its toxic contents, and burying it at a site where the possibility of potential exposure to human beings would be remote. At this time, the cleaning and decontamination of the tank does not seem to be a realistic alternative to deep burial.

Apart from the problems of disposal of the remaining residues, the damage caused by the residues that left the Verona site should be a clear warning to all manufacturers and agencies involved in the handling and disposal of toxic industrial wastes. The Missouri episode could have been much worse. In the words of Herbert R. Domke, the director of the Missouri Division of Health, "It is remarkable that it did not cause more human ailments."[4] □

When it became apparent that the dust-control spraying was the cause of the animal deaths, the soil in three arenas was removed and replaced with uncontaminated fill.



"Harry hardly has a civil word for the house plants, but he buttonholes every tree in sight."

NOTES

1 Carter, C.D., et al., "Tetrachlorodibenzodioxin: An Accidental Poisoning Episode in Horse Arenas," Science, 188 738-740, May 16, 1975.

2 Report by the Health Services and Mental Health Administration, Bacterial Disease Branch, Center for Disease Control, HEW, Atlanta, Georgia, Aug. 14, 1972.

3 Columbia Missourian, Feb. 7, 1975.

4 St. Louis Post Dispatch, Aug. 28, 1974.

MONS 206426

THE STATUS OF PCBs[1]

L. L RAMSEY

Associate Director for Regulatory Programs
Office of Compliance, Bureau of Foods
Food and Drug Administration
Washington, D C. 20204

I welcome this opportunity to review the major developments in the area of polychlorinated biphenyls (PCBs) and to discuss their current status with respect to food. The subject appears to be of more than ordinary interest not only to the FDA but to other federal agencies and to you in state and local food regulatory control work as well. In fact, the problem of PCBs is one we share with public health and environmental control officials in all countries of the world. Like DDT, PCBs do not recognize any national boundaries.

The polychlorinated biphenyls (PCBs) comprise a family of organic chemicals of quite remarkable chemical and physical properties. PCBs are manufactured commercially under the tradename Aroclor by the Monsanto Chemical Company, the sole manufacturer in the U.S. They were first produced commercially in 1929. The chlorine content of individual useful products varies from about 20-70% by weight; those up to about 54% are liquids and those above 54% are solids. The PCBs are extraordinarily stable and chemically inert, have a high dielectric constant and a high boiling point, are non-flammable and very resistant to decomposition by heat.

Industry rapidly capitalized on the unique properties of PCBs and began using them for a variety of purposes: insulating fluids in electrical transformers and capacitors, heat exchange fluids, hydraulic fluids, paints, plasticizers, printing inks, fire retardants, carbonless copy paper, and numerous other uses where electrical nonconductance, non-flammability and heat resistance properties are useful.

The PCBs are highly persistent in the environment; they resist both chemical and microbiological degradation. Thus, in 1971 the manufacturer announced that products for use only in closed systems such as electrical transformers and capacitors would be supplied. All others were being discontinued because of the potential for environmental contamination.

While PCBs had been widely used not only in the U.S. but throughout the world for almost 40 years, it was not recognized that there might be an environmental problem until Jensen identi-

[1]Presented at the 76th Annual Conference of the Association of Food and Drug Officials of the United States, Monticello, New York, June 18-24, 1972.

MONS 206427