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EFFECTS OF DIOXINS ON NATURE AND SOCIETY
OPENING TALK



CONTEMORI da "La Repubblica" del 25 settembre 1985

fig.1

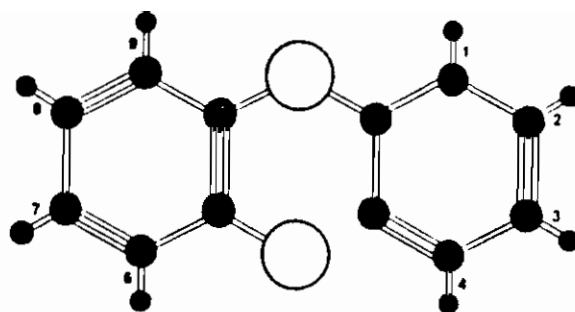


Fig. 2 - Molecular Structure of DiBenzo P-Dioxin

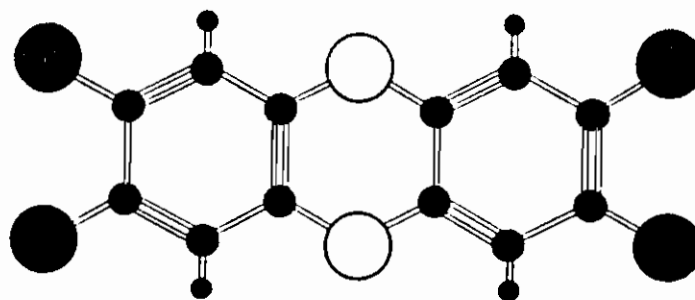


Fig. 3 - Molecular Structure of Tetra Chloro DiBenzo P-Dioxin

Taking advantage of the International Symposium on Dioxins and Chlorinated Compounds [DIOXIN 85] held in Bayreuth (Federal Republic of Germany) last week, some of us thought about the unique opportunity to have here in Pavia some among the most distinguished american scientists telling us about their experience on dioxin.

The Lombardy Region and the community of northern Italy experienced the Seveso episode. All of us heard about this specific case on the radio and the TV, but very few of us are aware of the fact that dioxin is not at all an "italian privilege".

The situation sketched in fig.1 [taken from the daily newspaper "La Repubblica"] needs at least a translation into english for the benefit of our distinguished guests.

We shall have, by all means, plenty of time in the future to eventually organize an "ad hoc" seminar on the italian dioxin case. However, this is the one and only chance we have our colleagues coming from the other side of the Atlantic Ocean, as guests of our University.

I mean :

- Ms. A. Betty Fischmann, Chief Dermatologist, Chairperson of the U.S.A. Chloracne Task Force, in Washington, D.C., who had to take care of the unpleasant consequences of the use of Agent Orange to the soldiers and the veterans returning from the Vietnam war;
- Lieutenant-Kernel Dr. Robert F. Olfenbuttel; Captain Jimmy

Corvette; Captain Terry L. Stoddart of the Environmental Research Complex of Tyndall Air Force Base in Panama City - Florida, who had to be concerned with the unpleasant job of taking care of the disposals of the "Agent Orange left over", when its use as an herbicide was forbidden;

- Dr. Donald G. Barnes, science advisor to the administrator of the Environmental Protection Agency [E.P.A.] in Washington D.C.; co-responsible for the several decisions made by the governmental authorities in the field of Environmental Protection;

- Dr. Robert J. Schreiber, former Director of the Division of Environmental Quality at the Department of Natural Resources of the State of Missouri, who led the project of converting the accident at Times Beach, Missouri into an active Research Center, dedicated to the improvement of our knowledge on Dioxin;

- Prof. Armon F. Yanders, last but not least: the distinguished colleague of the University of Missouri at Columbia, who directs the very active and qualified Environmental Trace Substances Research Center and who played an important role in directing on scientific ground the action of the State of Missouri in the case of the Times Beach accident.

Dioxin is a magic word. Not one human death has been reported as "definitely" attributed [by the health authority] to it, in spite of the several "accidents" in which dioxins were involved (Love Canal in upper New York State; Times Beach in the State of Missouri; The Agent Orange during the Vietnam War; the Chemi-

cal Industries in West Germany, in West Virginia, in Seveso; the several municipal incinerators in the Netherlands, in Switzerland, Canada and Japan).

Table I, elaborated by the American Medical Association, collects a series of known industrial accidents in which human beings have been exposed to dioxins, summarizing the effects directly observed. Although there were deaths, the statistical evidence is questionable [but, just because the evidence is statistically questionable, I would not be personally surprised if some surprising long term effect would show up, even in Seveso].

Dioxin is a magic word and it evokes a variety of emotional reactions. The general public is worrying about the public health (the American Broadcasting Company - ABC - has even telecasted a movie by the Title "Mrs. Gibbs of Love Canal", to tell the degree of public emotion around dioxin). Toxicologists know of the severe effects on animals, but are uncertain about comparable consequences on human beings [perhaps soft tissue sarcomas?]. Regulators are worrying because they must make decisions without having scientific certainties.

Dioxin is also used as the uncorrect abbreviation of Tetra-Chloro-Dibenzo-p-Dioxin, a chlorinated dioxin compound called more correctly TCDD.

The structure of dioxin is sketched in fig. 2. The dibenzo-p-dioxin consists of 2 benzene aromatic rings linked by two

oxygen atoms. From one to eight chlorine atoms can take the place of an hydrogen atom, attached to the carbon atoms [their positions are numbered in fig. 2] usually available in the aromatic chains, to form any of the 75 possible chlorinated dioxins. In fig. 3 the TCDD proper [TetraChloro=four chlorine atoms; Dibenzo=two benzene rings] is sketched.

At present, due to the anomalous circumstances quoted above and, at least partially, induced by the general emotional interest, dioxin has been studied so extensively that, in spite of the still numerous obscure aspects [the very late manifestation of epidemiological effects; the oncological and carcinogen manifestations, for instance] is becoming one of the best known toxics. Its migration in soil has been scientifically investigated; effects on guinea pigs, rabbits, monkeys, dogs, frogs have been studied. Even effects on some 60 volunteers are known.

Therefore, the learning of the U.S.A. experience on dioxins seems to be a very valuable contribution to the knowledge we need to put together. Not only for the so called experts but also for the student community of our University. It is an interdisciplinary subject which includes, among others, chemistry, genetic consequences, statistical evaluations.

The present Working Seminar has been organized jointly by the following Institutions as an interdisciplinary venture:

Dottorato di Ricerca in Fisica;

Dottorato di Ricerca in Scienze Genetiche (Genetica e Biologia

Molecolare);

Scuola di Specializzazione in Statistica Medica;

Societa' di Merceologia (Delegazione Lombarda);

Istituto Ricerche Sicurezza Industriale.

Therefore, while I have the privilege of opening the working session, I wish to thank the collaboration of prof. Alessandra Marinoni, prof. Luigi De Carli and prof. Vincenzo Riganti who, all together, made this Seminar possible.

All the Seminar is videotaped and will be kept in the arkives of the Departments of Physics of the University of Pavia. This will make available to those interested, also the valuable photographic material which was not provided with the printed version of the talks. This allowed dr. Silvia Cerlesi to reconstruct a summary of dr. Fischmann's talk.

Warm thanks are due to mr. Luigi Valla and Edgardo D'Uscio who take care of the videotape.

At this point, it is a pleasure to take the opportunity of having the floor, to welcome our distinguished foreign friends, whose contributions will be unequalled.

Finally, thanks are due to the Rector of the University for having made the distinguished "Aula Scarpa" available to us.

Last but not least, I personally wish to thank my closest collaborators dr. Silvia Cerlesi and ing. Giuseppe Belli for the most valuable and open collaboration given in any moment of my activity in the field of dioxin.

TABLE I: SUMMARY OF INDUSTRIAL CHEMICAL ACCIDENTS

YEAR	PERSONS EXPOSED	SITE	BRIEF DESCRIPTION OF THE EFFECTS
1949	250	Monsanto plant in Nitro West Virginia	122 chloracne cases; 32 deaths, while 46.6 were expected. No excess deaths from malignant neoplasms or circulatory disease observed.
1953	75	BASF plant in Ludwigshafen (FRG)	55 chloracne cases[42 severe] 17 deaths while 11 to 25 were expected. Four gastro-intestinal cancers and 2 oat-cell lung cancers. Most common injuries: impaired senses and liver damages.
1956	not given	Rhone-Poulenc plant in Grenoble	17 chloracne cases; elevated lipid and cholesterol level in blood.
1966	not given	"same"	21 chloracne cases.
1963	106	N.V. Philips plant in Amsterdam	44 chloracne cases[42 severe]; 21 had internal damage or central-nervous-system disturbances; 8 deaths, 6 possible myocardic infarction. Symptoms of fatigue observed.
1964	61	Dow Chemical plant in Midland Michigan	49 chloracne cases; 4 deaths while 7.8 were expected; 3 cancer deaths, 1.5 expected; [1 of soft tissue sarcoma].
1965-69	78	Spolana near Prague; continuous leak	78 chloracne cases; 5 deaths. Some 50 workers observed for over 10 years; hypertension, elevated lipid and cholesterol levels in blood; prediabetes; severe liver and neurological damages.
1968	90	Coalite and Chemical plant in Derbyshire	79 chloracne cases; 1 death from coronaris thrombosis
1976	156	Icomesa plant Seveso, Italy	More than 500 residents treated for possible toxic symptoms. Confirmed 134 chloracne cases. Overall normal mortality observed.

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DIOXIN IN MISSOURI

Missouri is sometimes referred to as "The Dioxin Capital of the United States." It's not that we have more dioxin than any other state, for we probably do not: estimates of the total amount produced in the state range between 50 and 150 pounds, and I suspect that several other states will be found to exceed this by a good margin. The problem in Missouri is that our dioxin, the most toxic isomer, 2,3,7,8 tetrachlorodibenzo-p-dioxin, is located in so many different sites which are inhabited. There are now more than 40 confirmed sites of dioxin contamination in Missouri, and the number may grow even larger. For the most part, the sites are located in the east central part of the state, near St. Louis, and the southwest part of the state, near Verona, where the chemical plant that produced the dioxin is located.

The dioxin was produced as an unwanted byproduct during the manufacture of hexachlorophene, an antimicrobial agent. The hexachlorophene was being manufactured in a portion of a chemical plant built by the Hoffman-Taff Company which was leased to the Northeast Pharmaceutical and Chemical Corporation, or NEPACCO. One of the final steps in the process was distillation, and the dioxin was at its greatest concentration in the residues remaining in the still. NEPACCO arranged for the disposal of these still-bottom residues with an independent contractor. Russell Bliss, a waste-oil recycler, was hired to collect the wastes, and he ultimately hauled some 18,500 gallons from the plant in Verona back to the St. Louis area. The majority of this material seems to have been mixed with waste oil in a large storage tank. During 1971 and 1972, this mixture, or in some cases possibly

the undiluted wastes themselves, were used as sprays for the control of dust on roads, parking lots, and horse arenas.

One arena which was sprayed was at the Shenandoah Stables, north of Interstate 70 in east central Missouri. On May 25, 1971, the dirt floor inside the arena was saturated with what may have been undiluted still-bottom wastes. The next day a horse became ill, and within a week, five more. In the next few weeks, horses died, cats and dogs died, and hundreds of birds were found dead. The horses that were affected lost hair and became exceedingly emaciated. An autopsy of one showed "emaciation, dermatitis on both hind fetlocks, diffuse suppurative pleuritis, and ulcerative gastritis." Various veterinarians, as well as toxicologists from the Centers for Disease Control (CDC), were unable to identify the toxic agent.

At this point, only a few people in Missouri were aware there was a problem. The owners of Shenandoah Stables certainly were, for they lost, in final count, some 62 horses that died or had to be destroyed, and the two daughters of one of the owners, Judy Piatt, became quite ill after playing in the arena in the summer of 1971. For the next year, Judy Piatt and Frank Hamphill, the other owner, followed Russell Bliss's trucks and compiled a list of the places they sprayed, as well as a list of the companies from which Bliss received other wastes. This list was sent in late 1972 to the Environmental Protection Agency (EPA) in Washington, to the CDC in Atlanta, and to the Missouri Division of Health. Times Beach was on the list. None of the agencies responded.

In July, 1974, CDC successfully identified the toxic material in a sample of soil from Shenandoah Stables as dioxin; until then it had been a mystery. CDC informed the Missouri Division of Health of its findings, and the Division of Health called Bliss, who said he had no idea where it might have come from. CDC investigation finally traced it to NEPACCO. In 1975, some soil from other sites that CDC tested also proved to have dioxin, and they informed the newly formed (1974) Missouri Department of Natural Resources. That department took no action, relying on evidence cited by CDC that the half-life of dioxin was one year or less, and assuming that time would take care of the problem of contaminated soil, if it had not already done so.

Besides, the state's main concern at that time was a large tank of liquid waste heavily contaminated with dioxin that had been found at the chemical plant near Verona, now owned by the Syntex Company. It contained 4,300 gallons of still bottoms and an estimated 13 pounds of dioxin. Finding a way to dispose of this was to preoccupy the state for several years. The Syntex Company did successfully treat the liquid, removing more than 99 percent of the dioxin by a photolytic process, but the contamination in the rest of the

state did not abate.

During the early 1980's, EPA had been quietly sampling some Missouri sites, and was coming to the conclusion that the original estimate of dioxin's half-life of one year was grossly in error. The agency asked the owners of some of the more highly contaminated sites to avoid exposure and to close their horse arenas voluntarily. Only a few people had been warned of the problems when an environmental group based in Washington released a list leaked from government agencies of over 50 potentially contaminated sites in Missouri, 14 of them confirmed. One of the potential sites was Times Beach. The publicity resulting from this news was intense.

Sampling of the potential sites began on November 30, 1982, at the largest one, Times Beach. Wearing their protective "moon suit" gear, the EPA completed sampling on December 3rd, when the sampling team was told it had to leave because of an impending flood. One said, "Migod, this town can't flood!" But the next day began the largest flood in Times Beach history. The Meramec River crested at 22 feet over flood stage, inundating the town.

Before the flood, Times Beach was a pleasant, lower-middle class community with over two thousand inhabitants. It had suffered from floods before, but as the people began to move back to their homes and businesses in late December, they found that many homes and businesses were not just damaged, they were ruined. Furthermore, they learned that an analysis of the soil beneath some streets showed traces of dioxin. People in Times Beach had arranged for this analysis with funds they had raised themselves because they felt they weren't getting answers from EPA or CDC. Nevertheless, they began to clean up their town with the full expectation of resuming normal living again. They were wrong, and for many of them began a nightmare which still continues.

At this point, just before Christmas, 1982, things began to move much more rapidly. Rita Lavelle, assistant administrator of EPA, finally released the laboratory reports that showed high levels of dioxin in Times Beach. On December 23rd, CDC relayed an advisory to the Missouri Division of Health recommending that people stay out of Times Beach. Residents who were temporarily relocated because of the flood were discouraged from moving back. Residents who had already begun to move back were encouraged to leave. This news, which was released by the Division of Health, reached many of the residents at the town's annual Christmas party in City Hall. It was crushing news, perhaps even more so because of the timing.

Times Beach immediately became notorious. For a month or two, anyone in the nation who read newspapers or watched television received regular doses of news about Times Beach. Pressures for EPA to do something mounted in Washington. In response to this pressure, on February 22, 1983, the EPA administrator came to St. Louis to announce that the government would pay 90% of the \$36.7 million necessary to buy out Times Beach. The state of Missouri was to provide the remaining 10%. This action probably would not have been taken if Times Beach had not attracted the attention of President Reagan. It was the only dioxin site in Missouri which did.

Pressures in the state of Missouri were also mounting, and the Governor, who had been relying on dioxin advice from key state government officials, appointed a Task Force on Dioxin with the charge to "recommend a practical and effective plan of action for implementing comprehensive and permanent solutions to the public health and environmental problems caused by dioxin in Missouri." The Task Force was composed of prominent citizens, and included physicians, scientists, lawyers, industry executives, and concerned citizens. The Task Force heard evidence from many sources, including EPA,

CDC, the Veterans Administration, and representatives of the Special Office in Italy that directed the cleanup program after the Seveso incident. The Task Force worked rapidly, and its Final Report was released in October, 1983.

The Final Report included three major recommendations, as follows:

"I. The Task Force recommends that secure central storage of Missouri's soil contaminated with dioxin exceeding acceptable limits should be provided until proven technology is available to assure a comprehensive and permanent solution to dioxin contamination with minimum risk to public health and the environment.

"II. The Task Force recommends that health studies on Missouri citizens potentially exposed to dioxin in residential, manufacturing or other occupational settings should be continued and expanded to assess the long-term public health effects due to dioxin.

"III. The Task Force recommends that the Missouri Dioxin Strategy for secure storage of dioxin contaminated soils and for assessment of health effects, as stated in this report, be adopted and thereafter periodically updated."

In making recommendation I, the Task Force recognized that there was no proven technology for destroying dioxin in soil economically, and it will probably be many years before one is developed. At the same time, it felt that the impact on Missouri and its citizens was so great that even a temporary measure which would safely sequester the contaminated soil was better than the current situation, in which the large number of contaminated sites poses a potential threat to a large number of citizens.

Recommendation II not only suggested that health studies be expanded to include more persons, but that Missouri should participate in research on such topics as the dioxin content of human adipose tissue and its use to determine background levels due to other exposures.

The Missouri Dioxin Strategy set forth in recommendation III consists of a set of eleven specific components and provisions. Those of greatest interest to this symposium include the following four, none of which has yet

been implemented:

- (1) "High priority should be given to the siting for and construction of a central storage facility and interim storage as required."

In addition to geological factors, criteria for the site selection included State ownership, exclusion of parks and wilderness areas from consideration, and utility of the site following closure of the facility. Preliminary sketches of the kind of storage bunker that would be required incorporated some of the design features of the Seveso structures. This recommendation has met with a great deal of opposition in the Missouri legislature, and there is some doubt now as to whether a central storage facility ever will be politically acceptable.

- (2) "A primary aim should be the reconstruction and reinhabitation of all sites."

The Task Force felt that it was not enough that the sites simply be cleaned up, but that the integrity of the affected neighborhoods and communities be maintained, and the financial burden to the people minimized. It was recognized that the site residents have already had their lives disrupted and have been subjected to severe emotional stress, problems which are not solved by property purchases.

- (3) "The experience gained at Seveso, Italy, should be utilized to the extent possible."

The Task Force was impressed by the way the Lombardi Government and the Seveso authority had addressed the problem, and recognized that Italy has developed much information on worker protection, sampling techniques and construction engineering which is directly

applicable to the Missouri situation. It pointed out that one of the problems encountered in Italy was the delay in obtaining analyses during excavation, and recommended that the state address this before any excavation begins.

- (4) "The residual level of dioxin allowed to remain after excavation and decontamination must be specified."

The Task Force suggested that the Centers for Disease Control establish permissible levels of cleanup which would permit unrestricted use of residential and agricultural properties, and further suggested that other, presumably higher, residual levels might be permissible for restricted use in commercial and industrial settings.

What is happening now to Times Beach? The Corps of Engineers is working on a levee to protect the area from the strongest river currents in case another flood occurs. The City Hall was destroyed by a fire, probably started by vandals, and the city government has set up shop in a trailer just outside the entrance to Times Beach. Homes, businesses, and churches are abandoned, and tall weeds are replacing the grass and flowers that used to be there. It is not uncommon to see wild deer in the streets: they seem to have discovered that there are few intruders in the town, because only one house is still occupied and the only access road is controlled by 24-hour security guards. But one still can find painted signs on buildings such as one over a garage door showing the high water mark of the flood ("The Big One-'82"), or one on a house which, misspellings and all, conveys the despair of the homeowner ("For Sale to U.S. Government - I losted my family because of DIXION - There's no one to take care of me now".)

For the time being, Times Beach and most of the contaminated sites in Missouri remain on "hold". The buyout of Times Beach is not yet complete, and there is no consensus as to what will be done with the town when it finally belongs to the State. In Southwest Missouri, the EPA mobile incinerator has had a successful burn, and the liquid wastes remaining after the cleanup by Syntex have been destroyed. A few cubic yards of contaminated soil have also been successfully incinerated. At a few sites near St. Louis, the contaminated soil is being excavated and replaced with clean soil, with the contaminated material to be stored indefinitely.

Times Beach has also become the center of a new activity. Following the recommendation of a Research Advisory Committee, which was formed with the cooperation of the Missouri Department of Natural Resources and the University of Missouri, the State of Missouri has established a Dioxin Research area at Times Beach. A major objective of this project is to identify methods which have the greatest potential to detoxify dioxin-contaminated material, and to evaluate those methods which appear to be successful. Perhaps the research done at this site will make Missouri "The Dioxin Capital of the United States" for its contributions to solving a problem that impacts on us all.

