amount of data in its files are secret Executive Branch guidelines, promulgated by former Attorney General Edward H. Levi, in 1976. Officials with knowledge of the secret guidelines refused to discuss them, even in general terms, with *Science*. However several officials declared that they are "very rigorous" and "carefully enforced."

But the secret nature of the guidelines, as well as the fact that they exist at the whim of the Attorney General, has provoked calls for other rules governing NSA eavesdropping, laid down by the courts or the Congress. The proposed wiretap law, which was drafted by the Carter Administration (although NSA fought it in Administration circles), requires a court-ordered warrant before any Americans in the United States can become "targets" of intelligence community surveillance. At that time, a judge would also approve procedures for minimizing the collection, retention, and dissemination of unwanted messages. But Senator Bayh is among the members of Congress who think that the "minimization" procedures in the current proposed bill have too many loopholes and could allow NSA's alleged "covert, intrusive surveillance" of Americans to continue.

Both the wiretap bill and the executive guidelines may let NSA keep the telegrams, telex messages, and other communications buried in their computers. In this sense, they are poor guards against later possible official abuse.

The feasibility of NSA's sorting of such quantities of material is also questioned. "Suppose they said they would not forward any communication to or from an American citizen," says one critic of the system. "Does that mean they run every message against a list of more than 220 million names before pulling it from the files?"

The ACLU's Lynch argues that NSA's dragnet search itself—a result of modern communications technology—may be illegal, since it may violate the Fourth Amendment's ban on general searches. He says, "If there's absolutely no way that NSA can target the messages for which it may have national security cause to collect without the dragnet, then other restraints must serve. But the NSA has to prove that—the burden is on them. And they haven't because they won't talk about their technology.

"But under no circumstances should they be allowed to maintain the stuff they've picked up in their dragnet after they've used their key words, or whatever, to select out the stuff they had cause to seize," Lynch adds.

Legality of Economic Intelligence

One other aspect of the NSA's alleged vacuum cleaner technology for sweeping up communications to and from the United States has also come under fire. Much of the incidental telegrams, telex, and telephone communications material it scoops up has turned out to be potentially useful economic and business intelligence, that NSA has sent, on request, to other agencies. The issue was very much on the minds of the Church committee. Asked Church at one point:

> What are we to do about communications that fall outside the realm of traditional intelligence concerns, such as the vague category of economic or business intelligence? Are we to allow communications to or from U.S. citizens regarding economic matters to be intercepted, analyzed, and disseminated by NSA?
>
> In an era of economic crisis are the international phone calls and cables of American businessmen fair game for government computers?

Church's question is not yet answered.

But so far, these sweeping questions have barely received a public hearing, let alone any clear answers. Philip B. Heyman, professor of law at the Harvard Law School, says that these are some of many areas in which "Technology has ripped open all the law about the Fourth Amendment, and what constitutes a search and an invasion of privacy. And technology is still ripping it open." Heyman explains that, for decades, the law and the courts' interpretation of it, has lagged behind technology's growing ability to put people under surveillance. The NSA's alleged practice, Heyman says, is an example of the trend. "What happens is that technology outstrips the law, and then the law catches up to the technology bit by bit."—DEBORAH SHAPLEY

Seveso: The Questions Persist Where Dioxin Created a Wasteland

Few people outside the region of Milan in northern Italy had any reason to know of the town of Seveso until a year ago, when an industrial accident put Seveso on the map. On 10 July 1976, a batch reactor in a chemical plant there overheated and discharged downwind a noxious vapor laced with perhaps the most toxic of man-made substances—TCDD (2,3,7,8-tetrachlordibenzo-*p*-dioxin). Subsequent press reports almost invariably referred, with ominous double meaning, to the cloud over Seveso. Now, more than a year later, that overworked journalistic metaphor still describes the persisting uncertainties at Seveso.

Debate continues over how or, in fact, whether the most seriously affected area near the factory can be decontaminated so that the rougly 700 inhabitants evacuated can soon return to live there. Also left hanging are questions of the long-term effects on the health of those exposed to the dioxin contained in the cloud from the explosion. While there have so far been relatively few signs of serious illness among those exposed, so little is known about the effects on humans of dioxin that the casualty list at Seveso must be regarded as open-ended.

And now there seems to be a general sense of disappointment that a major opportunity has been missed to advance the scientific understanding of the behavior and effects of dioxin under such conditions.

Certainly, concern among those directly involved has not subsided. The confusion which followed the accident soon gave way to bitter recrimination. The Italian government has been criticized for indecision and inadequate action. Reports continue of conflict between central and regional authorities and of rivalries between individuals and institutions. And the operators of the ICMESA (for Industrie Chimice Meda Societa Anonyma) plant, where the accident occurred, have been pilloried in the press and parliament, particularly for a delay in identifying the presence of significant levels of dioxin, a delay which is said to have resulted in prolonging human exposure and making decontamina-

tion more difficult. The criticism has probably been more strident because the factory is foreign-owned—by the Swiss-based Givaudan Corporation, which is a sudsidiary of the big multinational, Hoffman-LaRoche.

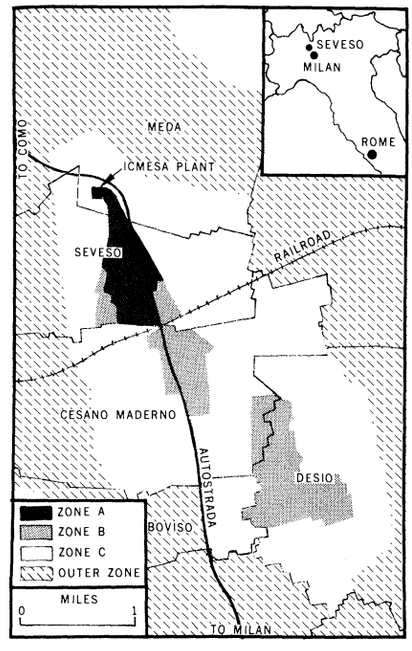
Not surprisingly, Givaudan and Hoffman-LaRoche officials, who are confronted not only with an enormous public relations problem but with the prospect of criminal and civil court proceedings, have struck a positive note in their public pronouncements. The company has sought to combat what it regards as false or exaggerated press reports—flatly repudiating, for example, a charge that the ICMESA plant was secretly engaged in production of chemical agents for NATO, and denying reports that other plants in the area had been closed because of dioxin contamination. And, after months of providing little information on any aspect of the accident, the company this spring began to make cautiously optimistic statements about the longer-term impact of the accident.

What sets the incident at Seveso apart is that the effects of an industrial accident spread beyond the confines of the plant to threaten the health of people living nearby and adversely affect the social and economic life of the area. The scale of the accident and the realization that a similar combination of circumstances could lead to such disasters elsewhere gives Seveso an international dimension.

Foreign scientists; including a number of Americans, have been drawn into the efforts to deal with the emergency. The call to foreigners is natural since there have been dioxin accidents in factories in Britain, the Netherlands, West Germany, and Czechoslovakia, as well as the United States. American scientists had a special contribution to make since the U.S. military had unique experience in spraying huge quantities of dioxin-containing herbicides in Vietnam. Vietnam provides the only major example, besides Seveso, of exposure of humans to dioxin outside factory confines.

The reactor breached in the Seveso accident was used for making trichlorophenol (TCP), whose major commercial use is in the production of herbicides. Givaudan says it shipped all the TCP made in Seveso abroad, half to Switzerland and half to its plant in the United States at Clifton, N.J., where it was used in the manufacture of antibacterial products.

Dioxin, or TCDD, is a contaminant generated in the production of TCP. Manufacturers go to great lengths to make as little of TCDD as possible. It is produced in a secondary reaction which occurs when temperatures rise beyond normal levels in the presence of the caustics employed in making TCP. The explosion in the reactor at Seveso is said to have happened under such conditions. A seal on the reactor ruptured and the contents were vented to the outside. The Seveso equipment did not have the heat control mechanism or the holding-tank backup system which are said to be standard for TCP production in the United States.



Seveso area

The accident occurred at midday on a Saturday as the plant was shutting down for the weekend. Versions of ensuing actions by local officials and the company tend to differ. But it took 2 weeks for Givaudan to complete the analysis which established the presence of dioxin in significant quantities and led to the evacuation of inhabitants of the most heavily contaminated area. A series of measures taken by authorities aimed at preventing the spread of the dioxin included cordoning off the area, killing pets and small wild animals in the area, and cutting and bagging vegetation. The evacuation affected inhabitants of Zone A, a cone-shaped area containing roughly 400 acres, and the most heavily contaminated of three zones established on the basis of sampling by the company for the presence of dioxin (see map).

An American called on early for advice on decontamination was Philip C. Kearney, chief of the pesticide degradation laboratory at the Department of Agriculture's Agricultural Environmental Quality Institute at Beltsville, Maryland. In addition to his general expertise in the subject, Kearney had been on the Pentagon panel formed to suggest ways to dispose of the stocks of Agent Orange, a herbicide with significant dioxin content, left over from Vietnam. The quarantine and initial decontamination measures taken at Seveso were consonant with Kearney's recommendations.

The State Department was the original conduit for requests from the Italian government for help from American scientists, and the National Academy of Sciences–National Research Council was called on by State to use its good offices with the U.S. scientific community. A task force was formed and Kearney and Alan Poland of the University of Wisconsin medical school were asked to go to Italy to make direct contact with Italian officials and scientists.

The most formidable practical task facing authorities is dealing with dioxin in the soil in the most contaminated area. Dioxin has penetrated the soil to a depth of as much as 10 or 12 inches. A proposal to scrape the topsoil in the contaminated area and then burn it in an incinerator constructed for the purpose has been offered as one possible course of action. It has encountered opposition from residents who feel that such operations would further blight the area and that the presence of such an incinerator might make Seveso a disposal site for hazardous wastes from other sections.

Kearney and others have misgivings about incineration. The scraping and burning of hundreds of acres of soil would be a Herculean job and the residue left from the incineration of soil would itself be difficult to dispose of. Scraping would also make it very difficult to keep track of levels of dioxin contamination throughout the area. Data on the location and quantities of dioxin are said to be quite extensive now, and scraping would invalidate this record. It would be impossible over time, for example, to establish how rapidly dioxin is degraded in particular conditions.

Other American scientists have contributed to the discussion of decontamination problems. One was environmentalist Barry Commoner, who was contacted while on a speaking engagement in Italy last September. Commoner was shown data and he made a visit to Zone A. The Italian press publicized several of his recommendations, including one that levels of contamination be better defined through studies of the mutagenesis of bacteria. Commoner has had no recent word on whether his recommendations were followed.

Commoner, who heads the Center for the Biology of Natural Systems at Washington University, and Robert E. Scott

of the center, prepared a report for Italian authorities on dioxin contamination in four horse rings in Missouri in 1971, and another report on and an analysis of Air Force studies on the stability of dioxin in the soil and its biological effect on wild life.

The Air Force studies, by Captain A. L. Young and others, also provided the basis for advice provided by Berkeley chemist Melvin Calvin, 1962 Nobel laureate. Calvin says it was clear that activated charcoal fixed dioxin in the soil, so he suggested that it be spread at Seveso and the dioxin be allowed to degrade by bacterial action. He suggested spreading cow manure to assist the process of bacterial degradation. As far as Calvin knows, his advice was not followed.

As Calvin observed, dioxin is known to decompose in sunlight fairly rapidly, and some scientists have advocated relying on photodecomposition as the main way to decontaminate the area. There has been some limited experimentation with this method at Seveso, but neither this means nor other experimental methods suggested, such as anaerobic decomposition, have been accepted as sufficiently sure and rapid. As Kearney and others say, developed technologies for decontamination adequate to the job at Seveso simply aren't available, in part because they have never been needed.

One of the most poignant human problems at Seveso is the question of what to do about the houses in Zone A, many of them built over the years by their owners. Some houses on the outer fringes of the evacuation area have been decontaminated by the company, but others nearer the factory still yield high readings of dioxin. The only course may be to raze these houses with all their contents.

While problems of decontamination heavily affect the lives of the people of Seveso, it is the implications for the health of those exposed to the chemical cloud which is the more serious concern.

A telltale sign of dioxin exposure in humans is chloracne (chlorine acne). The appearance of chloracne is similar to that of acne vulgaris, which affects adolescents, but people with heavier exposures to dioxin often develop rashes covering much of the body, and these may be serious enough to require hospitalization and can be disfiguring.

Immediately after the accident at Seveso, several cases of skin rashes were re-

Four Medical Schools Draw the Line on Capitation

In the name of the U.S. Constitution and the preservation of academic freedom, four of the country's most prestigious medical schools are threatening to reject federal aid rather than participate in a program that would force them to admit U.S. citizens who want to get into an American medical school after studying for 2 years abroad. Almost by definition, most of these students are individuals who were turned down by U.S. schools in the first place. Now, under an inflammatory provision of the Health Professions Educational Assistance Act of 1976 (*Science*, 12 November 1976), these students must be accepted by U.S. medical schools if they can meet a single (and not overly rigorous) requirement—a passing grade on the first or basic sciences part of the national medical board exam. In effect, the provision suspends all other academic criteria for admission to advanced standing and establishes the federal government as the medical schools' chief admissions officer.

Johns Hopkins, Harvard, Yale, and Stanford are among the leaders of a small group of some dozen schools that are preparing for a showdown with the government. Hopkins dean Richard Ross told *Science* that the four schools hired attorney Philip Lacovara—the man who recently resigned as chief counsel of the committee investigating the Korean lobbying scandal—to look into the issue on constitutional grounds. And Lacovara provided them with a 60-page brief challenging the law's constitutionality.

One of the ways in which medical schools receive federal aid is through capitation grants—a payment from the government for every student enrolled. Under what is known as the U.S. FMG (foreign medical graduate) provision, schools that refuse to take back U.S. students forfeit their right to all capitation money. Hopkins, for example, estimates it could lose $400,000 to $700,000.

According to Ross, Lacovara advised his clients that the provision violates the universities' rights under the First and Fifth Amendments, the point in the latter case being a violation of "due process" because the provision was, quite literally, written into the Act late one night by House and Senate staffers, with no public discussion whatever.

Furthermore, the Lacovara brief points out, the provision—the handiwork of Representative Paul G. Rogers (D–Fla.)—invades academic integrity, which the late Supreme Court Justice Felix Frankfurter defined in 1957 as this: "The four essential freedoms of a university are the right to determine for itself on academic grounds who may teach, what may be taught and how it shall be taught, and *who may be admitted to study*" [emphasis added].

Thus reassured of their position, the four schools have all filed notice with the Department of Health, Education, and Welfare that they will not accept returning students unless the unacceptable provision is dropped or modified.

Well aware of the furor which his provision has caused, Representative Rogers has come up with a bill that one observer described as a "have your cake and eat it too" measure. Rogers, who plans to hold hearings early in September, says he is willing to drop the language that usurps the admissions policies of individual schools, thereby eliminating the Constitutional issue. However, in its place he would put a reworded provision that would still force medical schools to accept returning students in order to get capitation money. Rogers' proposed solution is to require, as a condition of capitation, that U.S. schools expand their third year classes by at least ten students each. There being 118 medical schools eligible for capitation, simple arithmetic shows that at least 1180 students would have to be allowed to transfer and the only pool of such individuals is U.S. students in foreign medical schools.

The process of filing documents to be certified as eligible for capitation for the 1978–79 school year, when the admission of new third-year students is first required, has already begun. But it is not yet clear when the point of no return comes on a decision to take or reject the money. The majority of schools that simply cannot afford to sacrifice several hundreds of thousands of dollars a year on principle will take the students and the capitation money no matter how the Rogers provision is amended. But some, like Hopkins, Harvard, Yale, and Stanford, may, in the end, stand up for their rights.—BARBARA J. CULLITON

ported in children and adults. These appear to have been chemical burns from caustic compounds in the cloud. But within a few weeks a number of cases of chloracne were diagnosed.

The chloracne cases raised the fear that more insidious effects of dioxin exposure would appear. Heavy exposure to dioxin has caused death; lighter exposure has resulted in kidney and liver abnormalities, peripheral numbness, heavy fatigue, and reported psychological effects such as depression and irritability.

At Seveso, there were reports of illness after the accident, but these illnesses appear to have been short-lived. One difficulty in evaluating the state of health of the evacuated Seveso residents is that many of their complaints were treated at different hospitals or were seen only by private physicians, and the data collected are not regarded as complete or very reliable.

Clinically, therapy for dioxin exposure is limited to symptomatic treatment. There is no known agent, for example, that will accelerate the excretion of dioxin from the body, and patients who develop liver or kidney abnormalities after exposure can be given only supportive measures.

The largest and most systematic public health effort prompted by the accident was a mass screening of children for chloracne. This effort reached some 42,000 children in the area, mostly in February and March. About 600 suspected cases were identified, but the total number of confirmed chloracne cases over the year is put at 134.

Reexposure Feared

James Taylor, a dermatologist at the Cleveland Clinic, who has made two trips to Italy to consult on the chloracne problem, says that what was disturbing and "epidemiologically significant" about the screening was that it turned up new cases of chloracne in children who had not been in the Seveso-Milan area in July and August of last year. This provided evidence that there was still sufficient dioxin in the environment several months after the accident to cause chloracne. It also raised concern about possible reexposure and stimulated demands for a renewal of efforts at detection of dioxin and decontamination.

The dangers of TCP to humans have been recognized since the early 1950's because of health problems suffered by workers here and abroad. But the role of dioxin was little understood because techniques for measurement of dioxin were inadequate to detect it in the quantities which could be harmful.

In the 1960's techniques were developed for detecting dioxin at levels of parts per billion and later, of parts per trillion (ppt). Dow Chemical, which has long manufactured TCP in connection with herbicide production, has contributed a number of studies to the fairly extensive literature on the effects of dioxin on laboratory animals. Dow scientists helped to establish that the amount of TCDD required to kill half the animals—guinea pigs, rats, and mice—exposed to dioxin was in the micrograms per kilogram range, indicating that dioxin is a very potent poison indeed.

Other work has demonstrated the teratogenic properties of TCDD. Studies on rats showed that dioxin in small quantities tends to kill the fetuses. Studies of dioxin metabolism showed that it accumulates in the body, particularly in the liver, but is apparently not as persistent in tissue as, for example, DDT, DDE, and PCB.

Effects on humans are much less well understood, but results of recent studies by James R. Allen, a University of Wisconsin medical school pathologist, have caused increased concern among scientists worried about dioxin toxicity in humans.

Attracting particular attention is a feeding study on primates. Allen fed 8 female rhesus monkeys 500 ppt doses of dioxin daily for 9 months. Within 6 months the animals developed anemia from which 5 of the 8 died between the seventh and twelfth month of the study. In addition there were changes in estrogen and progesterone levels indicating impact on the reproductive system.

Allen's results tend to support the presumption that adverse effects may result from long-term exposure to very small doses of dioxin as well as from a heavy single exposure of the sort sustained in a factory accident. This has serious implications for the inhabitants of Seveso if significant traces of TCDD linger in the environment.

As for the mutagenic and carcinogenic effects of TCDD on humans, the scientific picture remains unclear. In respect to carcinogenic effects, animal studies have shown a significant incidence of tumors, and Allen suggests that TCDD may be a promoter of neoplastic changes rather than an inducer of a particular kind of tumor.

Reports from Vietnam have noted an increased incidence of liver cancer after exposure to the herbicide Agent Orange, but a National Academy of Sciences task force reported that no such link could be reliably established.

In recent months, company spokesmen have begun to make statements on both the progress of decontamination and on the evaluation of potential health risks to people in the area. While these statements have noted the dangers of dioxin still present in the area, their tone tends to be fairly sanguine. An assessment written by the head of Hoffman-LaRoche's clinical research department, G. Reggiani, for example, noted that, "In the case of TCDD man seems to respond to a certain extent differently from other animal species, and in the case of Seveso—if one compares the lesions observed in other accidents—both the concentration to which the population has been exposed and the duration of exposure or the quantity ingested seem to have been considerably lower."

Hoffman-LaRoche has announced that it will pay for all material damage from the accident and has established an $11-million fund to pay compensation for individuals and firms. Things are moving very slowly on this front, however, and are likely to continue to do so while legal actions are pending and while so many questions about decontamination and future health effects remain.

If there is a consensus among American scientists about these long-term health effects it is that not enough is known about the extent of exposure of Seveso inhabitants or the mechanisms of dioxin toxicity to venture a defensible prognosis.

Missed Opportunity

However, a source of almost universal regret is that from the start a greater systematic effort wasn't made to maximize the scientific knowledge gained in the aftermath of Seveso. A widely held view was expressed by John A. Moore, acting associate director of the research resources program at the National Institute of Environmental Health Sciences, who said, "the world missed a golden opportunity to get a handle on dioxin exposure and what it means to humans. We didn't get exposure levels. Why they didn't take fat [lipid] biopsies, I don't know. The data just isn't there."

The scientists recognize that emergency conditions prevailed after the accident and that the people of Seveso made a point of not wanting to be "treated like guinea pigs." But while the incident has focused attention in Italy on the impact of industry on the environment and human life, and internationally, Seveso has come to stand for the threat of a "chemical epidemic," it seems agreed that, unfortunately, the scientific lessons which Seveso offered have been, to a large degree, lost. —JOHN WALSH