Toxic fumes from fire-retarded foam

Because many plastics and polymers are extremely flammable, Federal regulations require that they pass various ignition and fire propagation tests before marketing. Usually the addition of some fire-retardant material during the manufacturing process provides the required flame protection, but little attention has been given to the possible toxicity of fumes given off by smoldering retardant-polymer combinations, heated by a surrounding fire. Initial results of such testing have revealed frightening possibilities.

A group of scientists at the Flammability Research Center of the University of Utah report in Feb. 28 SCIENCE on experiments exposing rats to the fumes of a polyurethane foam treated with a common phosphate fire retardant and heated until it begins to chemically decompose. After 20 minutes exposure to the smoke the rats all exhibited severely impaired ability to perform normal movements. Within an hour they developed grand mal, epileptic-like seizures. Depending on the concentration of retardant in the foam, some rats progressed to continuous major seizures and death.

Studies of blood samples from the dead rats indicated that when heated, the urethane had decomposed into chemicals that could react with the flame retardant to form toxic "bicyclic phosphate" compounds. Such compounds can cause seizures in concentrations lower than one part per million —small enough to escape notice by conventional smoke-analysis techniques.

In an interview, three of the scientists involved in the experiment, K. J. Voorhees, S. C. Packham and I. N. Einhorn, talked about the implications of their work. At first, says Einhorn, the results were viewed as "laboratory curiosities" since the polyurethane foam used in the experiments was not a commercial sample, but when subsequent Government and industry tests produced the same effects in flame-retarded foam already on the market, "all of a sudden we got a very quick response." Some products have already been withdrawn from public consumption and the National Bureau of Standards is accepting new sample materials from chemical companies, and sending them to the Flammability Research Center for toxicity testing.

But the problem is greater than just one class of retardants and products. "The results," says Packham, "point to a need for a new approach in toxicity testing." First, the discovery of toxic fumes from heated materials points to the need for direct biological testing of flame-retarded products—just finding out how much the ignition point is raised no longer appears sufficient. But more subtle effects are also involved: Such fumes may also impair judgment, their toxic effects may not appear until some time after exposure, and other kinds of poisoning—such as skin toxicity—may be involved.

When, for example, rats had been exposed to fumes from polyurethane foam that had *not* received flame-retarding treatment, they were able to "escape" from a plate-sized circle in less than six seconds. But rats exposed to the smoke from flame-retarded foam were so disoriented or convulsive that they could not move out of the circle in less than a minute—if at all. The apparent danger is that humans caught in a burning building containing similar materials might also become too disoriented to escape. The authors conclude that this effect might become evident well before otherwise "lethal" concentrations of smoke were present.

Despite initial skepticism, chemical companies are now cooperating with the Flammability Research Center, including some financial support, according to Einhorn. The new methodology developing out of this effort, he concludes, may lead to improved premarket screening of many kinds of flame-retarded materials. □

The ethics of human experimentation

Increasing attention has been given in recent months to ethical problems surrounding medical treatment and medical research. At the moment, concern is largely directed toward experiments on fetuses, prisoners and the poor.

The Congressionally mandated Commission for the Protection of Human Subjects, for example, is drawing up recommendations for Health, Education and Welfare on how to continue all forms of research while protecting basic human rights. Its first recommendations, on fetal research, will be announced on May 1.

Last week the National Academy of Sciences held a two-day symposium on the ethical problems of experimenting on fetuses, prisoners and the poor. Some 500 physicians, researchers, lawyers, philosophers and concerned citizens attended.

The subject that is receiving top priority by the commission and that drew much attention at the symposium is research on live fetuses. Since abortions have been legalized, fetuses have become widely available for research. And researchers have apparently been making wide use of these fetuses. Maurice J. Mahoney, a fetal researcher at Yale University, looked into the extent of live fetus experimentation for the commission. He reports that some thousand studies on live fetuses have been carried out, at least a third of them in the United States and Canada. Those conducted in the United States have largely dwindled, however, since the National Institutes of Health stopped funding research on live fetuses (SN: 4/21/73, p. 253).

Those who favor research on live fetuses argue that an aborted fetus is like a removed organ. The mother's decision or whatever caused the abortion, they say, has already doomed the undeveloped child. In such instances it seems more acceptable to these researchers to use the fetus for valid research than to dispose of it. During the few hours the fetus might live, for instance, the effects of drugs can be tested much better on it than on single organs or cell cultures. Such research, these investigators argue, will benefit fetuses destined to be born.

Experimenting on live fetuses, however, raises knotty ethical questions. At what stage does the fetus have human rights? At what stage does it feel pain? Scientists at the NAS symposium confessed that no one yet knows. But assuming that fetuses can feel pain, some of the experiments being conducted on them sound "like a horror story," in the view of Nobel laureate Frederick C. Robbins of Case Western Reserve University, one of the NAS symposium speakers. In one study, for instance, the heads of eight live fetuses (less than 12 weeks old) were cut off and then injected with radioactive compounds to study brain metabolism.

Speakers at the NAS symposium largely agreed that fetal research should be limited to dead fetuses. Such research presents no ethical problem, in the view of symposium participant Joseph Bellanti of the Georgetown University Medical School. He uses naturally aborted fetuses to study immunodeficiency diseases.

When the Commission for the Protection of Human Subjects makes its recommendations on fetal research on May 1, the NIH ban on funding live fetus research will be continued or rescinded.

As for experiments on prisoners, there is little doubt that they advance vaccine and drug research. Scientists at the NAS symposium underscored this point. Albert B. Sabin, creator of the Sabin polio vaccine, cited his own studies on "hundreds of prisoners" at a former Federal reformatory at Chilli-

cothe, Ohio, 20 years ago, when he fed them tamed polio virus to select the strains to be used in his oral vaccine. Prisoners are also ideal subjects for drug studies, W. N. Hubbard Jr., president of the Upjohn Company said, because "the individual is not penalized by removing him from his alternate activities to devote time to the experiment. Since these same people typically have limited opportunity to contribute to the general welfare, participation in efforts carrying large potential social benefits adds to their self esteem." Sabin agreed and provided letters from prisoners as proof.

On the other hand, there is evidence that prisoners have been exploited in some medical experiments. Alvin J. Bronstein of the American Civil Liberties Union cited an example at the symposium where an Oklahoma physician, Austin Stough, left a trail of hepatitis through the prison systems of several states in the mid-1960's while his firm earned large sums of money testing drugs and selling blood plasma. And recently, Bronstein said, the directors of HEW and NIH have expressed their concern that prisoners are not adequately compensated for disabilities arising from their participation in Federal funded research activities.

"It is not so much the actual, occasional abuse of captive human subjects, but the potential for abuse which concerns me," Bronstein declared. "The combination of the secrecy with which prisons are operated and the general absence of post-experiment care makes the potential for abuse quite real." Bronstein called for a ban on prison research.

Meanwhile, the Pharmaceutical Manufacturers Association, which represents the nation's prescription drug companies, has issued a set of guidelines to make sure that drug studies on prisoners are conducted ethically. The guidelines assure prison subjects freedom from coercion, adequate medical protection, full information about the nature of the testing, suitable compensation, the right to withdraw from the study at any time and assurance that refusal to participate would not affect eligibility for parole.

One of the values of experimenting on the poor, pointed out at the NAS symposium, is that subjects are cared for by institutions rather than by private doctors. As a result, it is easier to conduct long-range studies on them than on private patients. On the other hand, it is unfair to the nation's 20 million poor that 80 percent of the nation's medical research is conducted on them, Henry W. Foster of Meharry Medical College pointed out. Foster, a black physician and scientist, asked researchers to consider a moratorium on research on the poor, or at least on those "who suffer the deepest, most grinding social and cultural deprivation," that is, the illiterate, senile, foreign-speaking and mentally incompetent. "In this age of heightened consumer awareness," he declared, "occurrences such as the Tuskegee syphilis experiment, the injection of cancer cells into uninformed geriatric patients and the deception of Chicano women seeking contraception cannot and will not be allowed to continue."

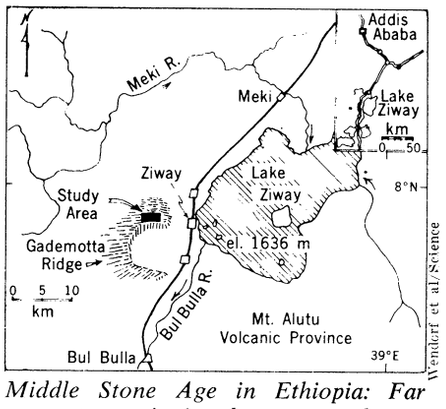
Franz J. Inglefinger, editor of the NEW ENGLAND JOURNAL OF MEDICINE, told Foster that halting research on the poor would deprive them of studies whose results they sorely need. Certain of the poor, he explained, are especially susceptible to infections, psychiatric problems and malnutrition. "An answer to malnutrition is food," Foster countered. "I once tried to get a grant to give them a drug, but not meat." □

Pill-related stroke: A certain risk

A relationship between oral contraceptives and high blood pressure in young women was first noted in 1967. In April 1974, the NEW ENGLAND JOURNAL OF MEDICINE reported that women on the pill are nine times more vulnerable to heart disease than are other women. A study reported in the Feb. 17 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION has followed up on previous reports, and has examined the influence of other possible risk factors, such as hypertension, smoking or migraine headaches on women using oral contraceptives. The report concludes that use of the birth control pill by itself can increase a woman's chances of having a stroke. But the chairman of the group, Albert Heyman of the Duke University Medical Center, says the chances of a woman of childbearing age having a stroke at all are extremely rare. One woman in 10,000 may suffer a stroke attributable to the pill.

Previous studies indicated that pill users who also had high blood pressure, migraine, blood vessel diseases and diabetes might have a greater chance of suffering stroke. The study indicates women with these conditions may indeed be particularly susceptible to pill-related strokes, but that the pill may cause a stroke when these conditions do not exist. "Combinations of risk factors are bad," Heyman says, "and women who already face an increased risk of stroke would be well advised not to use the pill." About 10 million American women currently take oral contraceptives. □

Tool scraps date Middle Stone Age



Middle Stone Age in Ethiopia: Far greater antiquity than expected.

Sediments taken from a Central Ethiopian volcanic ridge indicate that the technological developments characteristic of Middle Stone Age man may be much older than suspected, a report in the Feb. 28 SCIENCE says. Because scraps from Middle Stone Age tools were covered by volcanic ash rich in sanidine crystals (alkali minerals of feldspar), scientists could use potassium-argon dating to determine the age of this find. It was a stroke of luck, Robert Scarborough of the Laboratory of Isotope Geochemistry at the University of Arizona says, that the researchers found tool flakes so close to volcanic debris. Stone Age people were probably attracted to the area by the outcrops of obsidian and by its close proximity to Lake Ziway.

Although the specific location of the volcano involved has not been determined, the excavation site is in the Galla Lakes region. Two of the three samples dated were from airfall ashes, and were virtually covered by volcanic dust at the time of an eruption. The oldest tool scrap dated was about 200,000 years old, or about five times as old as carbon-14 tests had indicated. Although other findings suggest tools were used in Africa three and a half million years ago, Scarborough's group has established that tools were almost certainly used 180,000 years ago. □

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