there are other reasons, too. Another young campus administrator brought his wife and family to Manhattan (population, 27,000) from St. Louis, Mo. "Back in St. Louis my kids couldn't ride their bikes to get their hair cut because of the freeways. Here the streets are safe." And Hathaway, who came from Texas 6 years ago, says, "there's a certain life on this campus. We have the life, a spark without too much heat. Heat never adds anything when you're doing research."

The man who has presided over KSU's remarkable journey into the 1970's is its president, James A. McCain, 63. He came to Kansas State as president in 1950, succeeding Milton Eisenhower who had been KSU's president since 1943.

At a time when university presidents have been popping in and out of their jobs like puppets in a Punch and Judy show, McCain's 21-year tenure on the scene has become something of a local legend. He arranged the Nixon visit, promoted the university construction boom, and is generally responsible for the school's favorable publicity. And he is probably the only university president in the country who still leaves the door to his office open when he talks to reporters. In June 1973 he will retire. His future? "McCain could run for office from anywhere in Kansas tomorrow and get elected," a colleague said, "and there aren't many college presidents in the country who could do that."—DEBORAH SHAPLEY

Hexachlorophene: FDA Temporizes on Brain-Damaging Chemical

The Food and Drug Administration is preparing to take limited action against certain uses of a brain-damaging chemical some 18 months after scientists in one of the agency's regional offices first raised doubts about the chemical's safety. The chemical, hexachlorophene,* is an antibacterial agent used in a wide variety of soaps, shampoos, deodorants, creams, and sundry cosmetics. Hexachlorophene will probably turn out to be quite innocuous in most of its normal uses, but because of confused and dilatory action, the FDA and the industries it is supposed to regulate have not yet managed to assess the potentially serious hazards the chemical presents.

The chief of these hazards is that small concentrations of hexachlorophene produce microscopically visible damage in the brains of rats. Since the chemical is absorbed through the skin, it may reach harmful concentrations in the blood, particularly of people who make heavy use of hexachlorophene-containing products. A second danger, even less well assessed, is that hexachlorophene may contain as a manufacturing impurity the group of chemicals known as dioxins, minute quantities of which can cause violent skin eruptions and acne.

Hexachlorophene has enjoyed more than two decades of safe use as the standard antibacterial agent of soaps. This record was chiefly due to the responsible policy of the Swiss-based Givaudan Corporation, which developed and patented the chemical. Contrary to its best commercial interests, Givaudan sold hexachlorophene only to companies that could demonstrate a safe and effective use for it in their products. When Givaudan's patent expired 3 or 4 years ago, so did its control. Regulation passed to the FDA, which has placed virtually no restrictions on the chemical.

Because of its extreme toxicity, Givaudan refused to sell hexachlorophene for such internal uses as in throat lozenges. But the FDA has countenanced its use in toothpastes and mouthwashes. Hexachlorophene is now an ingredient of some 300 to 400 products, ranging from fungicides for vegetables and citrus fruits, to shoeliners, shampoos, and after-shave lotions. Among its most needless uses is in vaginal deodorants, a $53 million-a-year racket founded on high pressure advertising and the ruthless exploitation of modern phobias about body odor. (Hexachlorophene is not even effective against the type of bacteria chiefly responsible for vaginal odor.) Like DDT, another chlorinated aromatic compound, hexachlorophene has become a common human additive, being present in the bloodstream in amounts typically of 1 part per billion. Such has been the consequence of regulatory responsibility passing from an industrial company to a government agency.

Danger signals about hexachlorophene have not been wanting, only ignored. Two unique diseases, chloasma and burn encephalopathy, have been associated with the chemical. Chloasma, described as a blackening of the face, was reported in 1961; burn encephalopathy, a state of coma and muscle twitching often observed in burn patients treated with hexachlorophene, was described in 1968 by D. L. Larson of the Galveston Shrine Burn Institute. Chloasma and other skin diseases that have periodically been associated with hexachlorophene should have been particularly suggestive to would-be regulators. Hexachlorophene is synthesized from 2,4,5-trichlorophenol, the same chemical that in the manufacture of the herbicide 2,4,5-T is known to give rise to dioxin. Dioxin was found in the mid-1960's to cause the gross skin disease, named chloracne, that disfigured workers in a 2,4,5-T plant.

Equally suggestive should have been the finding, first announced in 1967, that hexachlorophene can enter the body not just via wounds and burns, but through the intact skin. No one in the FDA seems to have been bothered by the thought that a poison intended for external use only might daily be reaching the bloodstream of millions of users.

Nonetheless, though for a quite different reason, it was an FDA scientist who first raised the lid on hexachlorophene. Because of a manufacturer's application to use hexachlorophene as a fungicide, a test of the chemical's toxicity was undertaken at the FDA's toxicology branch in Atlanta, Georgia. Renate D. Kimbrough and her colleague Thomas B. Gaines found that rats became paralyzed after a 2-week diet containing 500 parts per million (ppm) of hexachlorophene. Examining the rats' brain and spinal cord, they

* Hexachlorophene is known chemically as 2,2′-methylenebis(3,4,6-trichlorophenol).

noticed "a peculiar edema of the white matter resembling spongy degeneration. . . ." (The damage was reversible; animals removed from the diet recovered over a period of weeks.) Later studies established that the same brain lesions were produced (in 8 out of a group of 10 rats) by a diet containing as little as 100 ppm of hexachlorophene, but no effect was observed with a diet of 20 ppm. In a review of these and other results that was finally published this August, Kimbrough concluded that "At the present state of our knowledge, the unnecesary use of concentrated hexachlorophene should be curtailed, and residues on food products should be reviewed and restricted when appropriate."

The relevance of the rat data to man was studied further by two other FDA scientists, Robert E. Hawk and August Curley, also of the Atlanta Toxicology Branch. Measuring the concentrations of hexachlorophene in the blood of rats, Hawk and Curley found that rats fed a diet containing 100 ppm of the chemical were carrying an average of 1.2 ppm in their blood (with a range of 0.985 to 1.48 ppm). Rats fed more concentrated diets of hexachlorophene had a proportionately heavier load of hexachlorophene in their blood. Blood levels measured in 12 human subjects with no unusual exposure to the chemical ranged from a minimum of 0.005 ppm, to 0.089 ppm for the subject who had made the greatest recent use of a hexachlorophene product. The latter concentration is almost a tenth of that which causes gross brain damage in the rat. These results were announced by Curley and Hawk in March at a meeting of the American Chemical Society.

Another important study by the four Atlanta scientists concerned the use in hospitals of concentrated hexachlorophene solutions to wash infants. In collaboration with Gerald Nathenson and Laurence Finberg of the Montefiore Hospital in New York City, they found that at the time of discharge from hospital the infants had accumulated blood levels of hexachlorophene averaging 0.109 ppm. The highest level recorded—0.646 ppm—was measured in a baby boy washed five times with a 3 percent solution of hexachlorophene. This level is more than half the blood concentration which causes brain lesions in rats.

What was the response of the FDA to the information emerging about hexachlorophene? In fact, the agency was learning almost nothing it had not already known since at least April 1971, at which time an FDA official announced, "We have no feeling of concern with hexachlorophene and at this time, with the information at hand, do not plan any regulatory action." The important work of the FDA's Atlanta scientists had been communicated to the FDA's Washington office a year beforehand, in April 1970, and in preliminary form as early as July 1969. Moreover, studies carried out by the FDA's Washington staff had brought to light serious data about the levels of hexachlorophene attained in human blood.

These studies, though not yet published, form part of an internal FDA review of hexachlorophene, a first draft of which was completed in June. Parts of the report were seen by Cecil H. Fox of West Georgia College, Carrollton, Ga., in the course of a study of hexachlorophene he made this summer as a member of Ralph Nader's Center for the Study of Responsive Law. From documents made available by Fox to *Science*, it appears that quite high levels of hexachlorophene have been detected in human blood by the FDA study. For instance, persons showering with pHisohex (a 3 percent solution of hexachlorophene) accumulated between 0.1 and 0.38 ppm of hexachlorophene in their blood. Mouthwash users who gargled once a day with a 0.5 percent hexachlorophene solution for 3 weeks built up an average concentration of 0.06 ppm hexachlorophene in their blood.

The highest level found in shower users—0.38 ppm—approaches a third of the average level that causes gross brain damage in rats. Another group of hexachlorophene user at risk are the 24 million Americans who use vaginal deodorant sprays. The residues of these sprays, once the volatile matter has evaporated, are surprisingly strong in hexachlorophene. Analyses conducted in the FDA Division of Colors and Cosmetics Technology show that Vespré, the number two best seller, contains 0.24 percent hexachlorophene in the bulk spray, but 98.5 percent in the residue left on the skin. FDS, the market leader, contains only 0.08 percent hexachlorophene in bulk, but 4.4 percent in its nonvolatile matter. The FDA has received a score of consumer complaints about vaginal deodorants in the last year and the manufacturers have had many more.

Another group of users at risk are acne sufferers, for whom strong hexachlorophene solutions such as pHisohex are the standard prescription. Besides the chance that hexachlorophene may enter the bloodstream in large doses, acne sufferers stand to have their condition exacerbated by any dioxin that may from time to time contaminate hexachlorophene samples. The extreme toxicity of dioxin—a single exposure of between 1 nanogram and 1 microgram will raise a visible reaction on the skin—means that levels below the ordinary limits of detection may still be toxic.

These and the other risks to users of hexachlorophene products are impossible to evaluate without more data than is at present publicly available. But the FDA seems to have been less than zealous in generating the necessary data. The most pertinent grant the agency is supporting is one that it grudgingly inherited from a Public Health Service program. Moreover, the data on hexachlorophene flowing in from the FDA scientists in the Atlanta Toxicology Branch was treated with a dilatoriness that amounted almost to suppression. The first news of Kimbrough's toxicity tests on rats started to reach the FDA in monthly reports dating from July 1969. A completed paper by Kimbrough and Gaines describing the microscopic damage caused by hexachlorophene in the brains of rats was submitted for approval to the FDA's Washington office in April 1970. After a 7-month delay, the paper was approved for publication and finally entered the public domain as an article in the August 1971 issue of *Archives of Environmental Health*. A major review of the literature on hexachlorophene was completed by Kimbrough for the FDA in May 1970 but took another 15 months to reach the public eye. Curley and Hawk submitted for publication in June 1970 their data on hexachlorophene concentrations in rat and human blood; the FDA refused permission to publish for 6 months, until in January 1971 the Atlanta Toxicology Branch was transferred to the newly created Environmental Protection Agency, a move that allowed the two scientists to make their work known at the American Chemical Society meeting this March.

To an alert administrator, the first reports from the Atlanta scientists should have set red lights flashing and bells ringing. The issues raised by the Atlanta experiments required urgent answers to such questions as what significance the rat data have for man.

Are humans more or less sensitive to hexachlorophene than rats? If a blood level of 1.2 ppm hexachlorophene causes gross brain damage in the rat, do lesser doses cause any detectable behavior change? What is the upper level of dioxin that could escape detection in hexachlorophene and yet still cause skin damage?

The FDA has had at least 18 months to answer these questions, but so far has neither acted against hexachlorophene nor set forth reasons for not doing so. Hexachlorophene may, in fact, be quite safe for most normal uses, but the longer the FDA delays announcing the reasons for supposing this to be the case, the greater the likelihood that political pressures rather than scientific data will decide the issue.

These pressures have already started to act, following the publication in August of the Atlanta scientists' work. The FDA has been working for 6 months on a second scientific review of hexachlorophene, the completion of which would, in normal circumstances, precede any regulatory action. Although the report is not expected to be ready for up to a month, the FDA announced last week, through the mouth of its press officer John T. Walden, that it will act "soon" to require warning labels on vaginal deodorants and liquid skin cleansers such as pHisohex. The industries concerned responded with the arrogance and strong-arm tactics that are known to pay off against the FDA. Leonard H. Lavin, president of the Alberto-Culver Company, which makes the market-leading FDS vaginal deodorant, fired off a telegram to FDA Commissioner Charles Edwards demanding that Walden be sacked for his "inaccurate, irresponsible and unauthorized statements about certain products containing hexachlorophene." (Walden's crime was to tell the Washington *Post* that there is no medical justification for hexachlorophene in vaginal deodorants.) Lavin demanded a meeting in Washington with Commissioner Edwards the next day. According to E. P. Doyle, Alberto-Culver's vice-president for public relations, "We had a meeting with Edwards on Friday afternoon and we feel satisfied that they will await more scientific evidence before taking any action. Our people feel the FDA doesn't have any good scientific information and was acting simply on the basis of generalized and somewhat biased articles," Doyle added.

The FDA's promise of further delay to Alberto-Culver may not be in either's interest, since countervailing pressure from Congress and consumers may rush the agency into a premature and unnecesarily harsh decision. And while the FDA makes up its mind, the public continues to bear whatever risk exposure to hexachlorophene may represent.—NICHOLAS WADE

RESEARCH TOPICS

Breeder Reactors: Power for the Future

The outcome of current efforts to develop breeder reactors will markedly influence both the configuration of the U.S. power industry and the cost of electricity to the consumer. Breeder reactors may offer lower thermal pollution, cheaper electric energy, and more efficient use of uranium reserves as compared to conventional light water nuclear power plants. The rapidly growing demand for electric power and forseeable shortages of high grade uranium ores make it likely that breeder reactors will constitute a substantial part of the world's electrical generating capacity by the end of the century. But development of breeder reactors on a commercial scale seems to be lagging behind in the United States amidst growing criticism of how the U.S. program is being run.

What is at stake in the development of breeder technology is nothing less than the future of the U.S. power supply. An error of judgment or execution could easily offset power rates to a degree that would, by the year 2000, result in additional expenditures of tens of billions of dollars per year for electricity. The timing of breeder development and the rate of fuel doubling in the breeders are crucial in determining how much uranium ore must be mined and what financial investment in new uranium separation facilities will be required before the breeders are self-sustaining.

Prototype generating stations powered by breeders, so called because the reactors produce more fuel than they consume, are nearing completion in France, Britain, and the U.S.S.R. Those in Britain and the U.S.S.R. are expected to begin producing electricity by the end of next year. Ambitious programs to develop breeder reactors are also under way in Germany, Italy, and Japan. Earlier this year, President Nixon announced long-delayed U.S. plans to build a demonstration plant, and has more recently indicated his support for a second such plant. But construction of such plants—which could take 6 to 7 years—appears unlikely to start before late 1973. Prospects for introduction of economically viable, commercial-scale plants are even more uncertain, although the announced intention of the AEC is to achieve this goal by the mid-1980's.

The future course of breeder development in this country depends heavily on AEC policy. What types of breeders will be built, how soon they will be available, and how economical they will be are closely connected to AEC decisions on research funding and reactor design—decisions that since 1965 have been made by Milton Shaw, head of the AEC reactor development and technology program. But despite the potential economic and environmental impact of this program, there has been relatively little public discussion of technical options or alternative policies for breeder development.

The U.S. breeder program as constituted at present is putting nearly all its hopes on one reactor concept—essentially the same as that being pursued in other countries. But this goal, and how it is being pursued, has aroused considerable disagreement within the U.S. nuclear community. Current designs, according to some critics, are so conservative that they may well be economically unattractive. Others have questioned the slow pace of the U.S. effort, despite relatively larger expenditures than, for example, those of Britain.