resulted in both the government and the meat industry. The Attorney General advised that the departments could not order a phased withdrawal of nitrite if it causes cancer, but they would have to impose a complete ban without considering nitrite's benefits. The USDA and FDA felt a sudden ban would pose a risk of botulism to the public. Congress was faced with the question of whether or not it should change the law, the Delaney amendment, requiring a ban on any food additive shown to cause cancer.

After the recent reevaluation of the nitrite data, Rep. William C. Wampler (R-Va.) called a press conference to ask Congress to adopt a new procedure for evaluating food additives. He charged federal regulators with using scare tactics in premature announcements that cause "near chaos" in industries affected by "these on-again-off-again regulatory announcements."

Even if nitrite does not cause cancer directly, it remains suspect on health charges. Nitrites can be converted during cooking or in the body to nitrosamines, which are known carcinogens. The FDA and USDA say they will continue their efforts to eliminate nitrosamines from foods. In addition, the pathologists point out that two very recent reports conclude that nitrite-fed rats have higher tumor incidences than do control animals. Those reports are now being reviewed by the Bureau of Foods. □

Put out the fire of fire ants

Photos: USDA

Fire ant colonies build 2- to 3-foot-high mounds that house hundreds of thousands of ants. They swarm out of the hive at the slightest provocation.

Fire ants began marching through Georgia in the 1930s after they were accidentally introduced into that state. And the pests, named for their fierce sting, have continued to march. They now infect 230 million acres in nine southeastern states, and they are spreading at a rate of approximately 30 miles per year. The insecticide mirex had been used to fight the ants, but it was banned in 1978 after it was found to be carcinogenic, to cause birth defects and to accumulate in the environment. Now there is new hope that the march of the fire ants can be halted. The Environmental Protection Agency has approved an insecticide called Amdro for use in wide area ant control programs.

Amdro belongs to a new class of chemical compounds called amidinohydrazones. Scientists at American Cyanamid Co. developed and tested more than 500 such compounds before hitting upon Amdro, which is applied to pastures, range grass, lawns, turf and non-agricultural lands (4 to 6 grams are distributed per acre). Because Amdro must be carried back to the mound by foraging worker ants if it is to be effective, it must be applied when soil temperature is more than 60° F and when the ants are active.

The fight against fire ants (also known as imported fire ants) is serious because they are more than picnic pests. They threaten both human health and agriculture. In 1979, for instance, one Georgia county treated more than 28,500 sting cases, says Joseph J. Garbarino of American Cyanamid. A fire ant sting produces a burning sensation, and the resultant itchy pustule can become infected. A fire ant can sting repeatedly, and victims are usually attacked by many ants at once.

Farmers suffer economic losses not only because of the ants but because of their mounds, which may be 18 inches high, 2 feet in diameter and house 250,000 ants. Livestock avoid the mounds, thus reducing grazing land. The mounds damage mowers, balers and other farm equipment so large sections of fields cannot be harvested mechanically. In addition, bales of hay left on the ground overnight cannot be handled because of already resident ants. The ants attack and sometimes kill young livestock and ground-nesting birds.

Short-term laboratory tests indicate that Amdro doesn't cause genetic changes or birth defects. Long-term studies are currently underway. Calvin Alvarez of American Cyanamid says their studies indicate Amdro doesn't accumulate in the food chain or in the environment, but instead is degraded by sunlight and by soil microorganisms. The insecticide has already been tested on approximately 100,000 acres of land, and Cyanamid hopes to sell enough insecticide to treat 1.2 million acres this fall. □

Unlocking buried geothermal energy

A unique form of geothermal energy lies deep in a part of Texas. Whether it can be used efficiently as an energy alternative is a question Myron Dorfman and colleagues at the University of Texas at Austin have set out to answer.

Dorfman and co-workers are investigating subsurface waters trapped at abnormally high temperatures and pressures. These aquifers eventually may be not only a third source of geothermal energy — hot-water and dry-steam fields are the two conventional forms of the earth's heat energy currently being tapped — but also a source of natural gas: The geopressured waters contain a significant quantity of dissolved methane. Although a 16,500-foot geopressured well was drilled last year to test the feasibility of gas recovery and geothermal energy production from these waters, an ownership change-of-hand forced the then only 10-day-old investigation to cease. Now the business barrier has been removed and tests are due to resume, reported Dorfman at the American Chemical Society meeting last week in Las Vegas, Nev.

The test well, about 35 miles south of Houston, sits on one of the largest geopressured zones in the world — one that underlies a large portion of the northern shore line of the Gulf of Mexico. Dorfman says there are seven other such basins in the United States and 42 in other countries. These geopressured zones are primarily the result of compaction phenomena: Newly deposited, water-saturated sediments eventually are covered by younger sediments. As the water-saturated rock is buried deeper, it begins to expel water; if the overlying rock is impermeable the water is trapped, and the weight of the rock keeps this water at higher than normal pressures. Underlying shales are believed to be the source of the methane in these geopressured aquifers.

Mathematical calculations indicate that the test well is capable of pumping 40,000 barrels of water per day, from which 1 million cubic feet of gas could be extracted. The total amount of recoverable natural gas in the geopressured aquifer is 200 to 250 trillion cubic feet. Known reserves of conventional natural gas in the United States are about 200 trillion cubic feet.

But, says Dorfman, "We can do paper studies all day long," and the figures "will mean nothing. That is why we have set out to study long-term [field] tests."

One field test will focus on determining the most efficient use of the hot waters. The aquifer waters — at temperatures 200° to 300°F lower than dry-steam and hot-water fields — may be cooler than what is necessary with present-day technology to yield geothermal generation of electricity. Other tests will assess the en-

vironmental impact of pumping the water out of the well. Although Dorfman and crew will be monitoring air, thermal and noise pollution, in addition to microseismic activity, their only real environmental concern is land subsidence. While subsidence of land is known to occur when water is withdrawn from very shallow depths, the effect of pumping water from much deeper depths, such as from the Gulf Coast aquifer, is not yet known. To monitor possible subsidence, highly sensitive tiltmeters have been installed at the well site. "If a cockroach walks across the location, I'll know about it," Dorfman says.

The environmental and water-utilization investigations, along with legal and institutional studies, will continue over the next two years. By 1986, Dorfman hopes to begin small-scale commercial production of gas from the basin, generating about 1 trillion cubic feet annually by the year 2000 (the United States now uses 19 trillion cubic feet per year). Dorfman expects little more than these small-scale geothermal developments as long as conventional sources of gas and oil continue to provide the best return on investment. Although he sees an "increased interest" in geothermal development, "accelerated activity" in the field is still "down the road." □

The quest for a catastrophe

The sudden extinction about 65 million years ago of half to three-quarters of the living species on earth, as evidenced by microfossils in sediment samples from the boundary between the Cretaceous and Tertiary periods, has intrigued researchers for many years. Last year, the University of California's Walter Alvarez and colleagues reported on samples from Italy and Denmark that contained excesses of the element iridium typical of extraterrestrial materials, inferring that such anomalies might have been due to a huge meteorite striking the earth. Dust from such an impact, they reported (SN: 1/12/80, p. 22), might have lingered in the atmosphere for several years, shutting off sunlight effectively enough to inhibit photosynthesis and cause the extinctions. Other scientists have subsequently found similar iridium anomalies in Spain (which also showed an excess of osmium) and New Zealand (SN: 6/14/80, p. 381).

Now a researcher has taken another look at samples from the Cretaceous-Tertiary boundary period in Denmark, measured concentrations of nearly all the noble metals (iridium, osmium, gold, platinum, nickel, cobalt, palladium, rhenium and ruthenium) and compared them with samples from meteorites—representing high, "cosmic" abundances — and from typical, "terrestrial" basalts from the Columbia River. And according to R. Ganapathy of the J.T. Baker Chemical Co. in Phillipsburg, N.J., the likelihood that the boundary samples are of extraterrestrial origin looks greater than ever. Not only did all of the elements on the list show up in the boundary samples at levels well above those normally seen in terrestrial materials, he reports in the Aug. 22 SCIENCE, but the pattern of their abundances generally matches the extraterrestrial one. (The boundary samples have lower absolute abundances than do the meteorite samples, but Ganapathy points out that the impact would have tossed up a lot of terrestrial material that would later mix with the resettling meteorite debris. The clay in the boundary samples, he says, now contains about 7 to 8 percent meteorite material.)

How big a meteorite might have been involved? The "part-meteoritic" boundary clay containing the noble metals studied by Ganapathy was in a layer about 2 centimeters thick. If the meteorite material was carried around by the atmosphere long enough to have been evenly distributed over the globe at that rate, the scientist says, the impacting object would have been 11 kilometers in diameter and weighed 2.5 trillion tons. (An alternate source of the "extraterrestrial" material—a nearby supernova — was discounted previously by Alvarez on the basis of plutonium 244 and iridium 191:193 data. Osmium 184:190 ratios, reports Ganapathy, support the same conclusion.) □

Noble-metal abundances in two clay samples from the Cretaceous-Tertiary boundary in Denmark, compared with abundances from a meteorite and from a terrestrial basalt.

Element	Sample 4 (207.8 mg)	Sample 5 (243.4 mg)	C1 chondrites (*4*)	Columbia River Basalt (*5*)
Ir (ppb)	47 ± 9	55 ± 6	514	0.0011 to 0.012
Os (ppb)	40 ± 1	49 ± 2	480	≤ 0.01
Au (ppb)	8.8 ± 0.2	12.3 ± 0.2	152	0.35 to 1.33
Pt (ppb)	24 ± 5	17 ± 6	900	
Ni (ppm)	310 ± 45	322 ± 35	10,300	7.3 to 13
Co (ppm)	38 ± 1	46 ± 1	483	28 to 38
Pd (ppb)	45 ± 8	53 ± 8	460	≤ 0.03
Re (ppb)	35 ± 1	59 ± 1	35	0.64 to 1.06
Ru (ppb)*	37 ± 28, 39		690	

*Ruthenium was determined only in sample 1

R. Ganapathy/Science

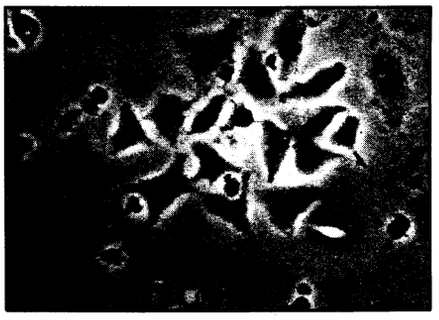
Ozone: Pollutant Slows cancer growth

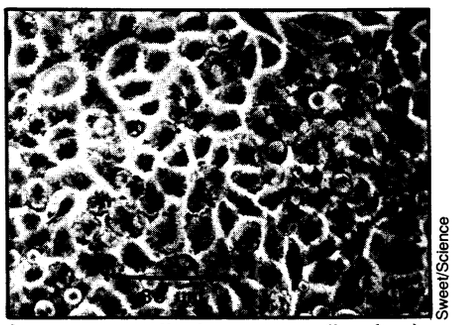
Ozone as an air pollutant causes major problems for persons with diminished lung function and it causes respiratory difficulties and discomfort in healthy persons. In the laboratory it causes problems for cancer cells. Ozone selectively inhibits the growth of cancer cells in culture, say five St. Louis researchers from governmental agencies and the Washington University School of Medicine.

The team, admittedly surprised by their discovery that cancer cells are more sensitive to ozone than are normal cells, made their finding while looking for a cell culture with which they could measure the harmful effects of pollutants. Using a chamber to hold cells in an ozone-suffused controlled atmosphere, they tested breast, lung, epithelial and uterine cancer cells and normal lung cells.

The growth rate of cancer cells, they found, was inhibited at a rate dependent on the ozone concentration, independent of the type of cancer. At 0.3 parts per million (ppm) of ozone, cancer cells reproduced at 60 percent of the rate of normal lung cells in the chamber; at 0.5 ppm, the rate of growth was 40 percent. When the researchers upped the ozone concentration to 0.8 ppm, cancer cell growth was inhibited 90 percent, and normal growth was inhibited less than 50 percent. "Evidently," they conclude, "cancer cells are less able to compensate for the oxidative burden of ozone than normal cells."

One possible mechanism, they suggest in the Aug. 22 SCIENCE, is that ozone affects glutathione molecules, which neutralize oxidizing chemicals by donating hydrogen atoms. As glutathione is used





Sweet/Science

Lung cancer cells show ozone effect (top).