somes, J. A. DiPaolo of the National Institutes of Health in Bethesda, Md., has found. "There may be two kinds of cancer," he says, "one which includes chromosomes and one which does not." In any event, the chromosomal damage that is exerted may consist of a breakage or rearrangement of preexisting chromosomes or the addition of new chromosomes. Such action, however, may not necessarily be as crucial as other actions of carcinogens in cells, notably their interaction with DNA (genes) that reside on the chromosomes.

There is no doubt that carcinogens attach to DNA, Michael Lieberman of the National Institute of Environmental Health Sciences in Research Triangle Park, N.C., reports. Both he and other researchers have found this. Lieberman and his co-workers have also noted that mammalian cells are able to shuck carcinogens off their DNA, at least to a certain degree. But is this action sufficient to protect the cell from the carcinogen? If not, then the chemical residue left on the DNA may be able to damage the DNA.

Such damage, in fact, has been documented, as gene mutations, by several research groups—by H. V. Malling and F. J. DeFerres of NIEHS in 1969, by Heidelberger, T. H. Corbett and W. S. Dove of the University of Wisconsin in 1970 and by Bruce Ames and his team at the University of California at Berkeley last year. Ames and his team, for example, found that of 300 carcinogens and noncarcinogens they tested, there was a correlation (90 percent) between carcinogens and mutagenicity and few noncarcinogens showed any degree of mutagenicity.

As a result, Ames concluded at the FASEB meeting that ". . . almost all chemical carcinogens cause cancer by mutation. A mutation damaging a normal regulatory mechanism in a cell can result in uncontrolled growth in that cell and in its descendants, thus giving rise to a tumor." Ames and co-worker Joyce McCann reiterate their conclusion in the March issue of the PROCEEDINGS and discuss its implications.

Not all scientists are convinced that mutations are the means by which carcinogens alter gene expression and turn a cell into a cancer cell, though. In Lieberman's view, for example, "A mutation may be one mechanism whereby you get an alteration in gene expression, but I don't think it is the only one." Still other researchers contend that carcinogens may turn cells into cancer cells not only through gene expression but through altering other aspects of the cell, since carcinogens are known to change not only the cell's genetic machinery (chromosomes and DNA), but its proteins, RNA, membrane molecules and small molecules, not to mention the surface of the cell and the immune system in the whole organism. Another possibility is that carcinogens trigger cancer through one of these routes exclusively. □

Chinese meteorite yields record chunk

A 3,894-pound meteorite, believed to be the heaviest observed fall on record, struck the earth in Kirin Province of northeastern China on March 8, according to the official Chinese news agency Hsinhua. (Much heavier stones have been recovered from unobserved falls.) The object was one of more than 100 fragments of a much larger meteorite that exploded overhead near Kirin City, scattering rocky chunks over nearly 200 square miles. Analysis of the chunks reportedly showed silicon, magnesium, iron, sulfur, calcium, nickel and aluminum. □

Wide World

Meteorite crater, two yards wide, six deep, is one of many from Chinese fall.

Quake prediction: Tale of two cities

On Feb. 4, 1975, a cataclysmic earthquake struck the town of Haicheng in Liaoning Province of northeastern China. It reached 7.3 on the Richter scale, damaged or destroyed about half the houses near the quake's epicenter (90 percent in some areas) and caused the death of an estimated 200 to 300 people. Because the quake was predicted in advance, however, "tens of thousands of lives were probably saved," says geophysicist Frank Press of Massachusetts Institute of Technology, strong evidence that "the Haicheng shock may well be the most significant earthquake in history." Last week another severe tremor—magnitude 5.5 to 6.5—was predicted for southern California's San Fernando Valley region some time in the next year, and whether or not that specific event occurs, there is concern that the United States may not be as prepared as it could be to meet seismic disaster.

The possibility of an impending California quake was announced by James H. Whitcomb of Calfornia Institute of Technology, based on seismic velocity changes along the San Andreas fault system east of Los Angeles. Geophysicists have also recently discovered evidence of a rise of as much as 25 centimeters in the elevation of thousands of square kilometers of land in the fault region, much of which may have taken place between 10 and 20 years ago. Whitcomb, who correctly anticipated an early 1974 quake around Riverside, Calif. (though it was a magnitude smaller than his estimate), thinks of his current projection not as a prediction but as "a test of an as yet unproven theory." To that end, he feels that scientists making quake projections should do so in writing, to help evaluate the various prediction techniques now being studied.

Equally important, if not more so, is the issue of what to do with such predictions once they have been made. The first proposed federal guidelines for evaluating predictions and responding to them were tentatively offered less than six months ago by Vincent E. McKelvey, director of the U.S. Geological Survey (SN: 11/15/75, p. 308). Instrumentation around the San Andreas fault region is insufficient for proper monitoring of the most seismically touchy area of the country, some geologists feel, and funds recently sought for the purpose were reportedly made available only at the expense of diverting them from other programs. Thus, the Chinese experience becomes particularly important, not only as information but, in the view of a number of researchers, as an indication to federal and California officials that preparedness is both possible and worthwhile.

In 1970, says Press, who gleaned details from the report of Chinese scientists at a UNESCO conference in Paris two months ago, Liaoning Province was declared to be "an important region for earthquake monitoring," based on its seismic history and high population and industrial densities. Professional seismological teams were organized to collect data and specifically charged with the task of making predictions. Fault activity, migration of strong quakes into the region, an increasing frequency of small quakes and a gradually growing rate of crustal deformation led to a preliminary estimate that the southern part of the province was due for a major tremor. Observations were strengthened from both fixed and mobile stations, and from July 1973 to June 1974, thousands of "amateur seismologists" were alerted to participation. Anomalous magnetic-field variations were detected, as was a rise in sea level at Liaotung Bay, and 1974 saw an increase in the seismic activity of the entire province.

In June of 1974, the Chinese Council of State, now guided by an interim prediction of a possible quake within one or two years, not only added further to the monitoring program but also initiated a major civil preparedness program. The provincial government took over control of the monitoring effort, and authorities

began a public education campaign about earthquakes themselves as well as about dealing with a possible disaster.

Precursory signs continued to increase. Besides growing crustal deformation and tilt, "a great deal of unusual animal activity was observed," an indicator that receives little attention in the United States although it has been noted for years in many parts of the world. "For example," says Press, "snakes came above ground and froze to death—an unprecedented phenomenon." A number of water wells in the area bubbled, grew muddy and rose in level. ("I only know of one that's being monitored in California for level," Press observes.) With the occurrence of a magnitude 4.8 quake about 40 kilometers north of Haicheng, officials instituted checks of all reservoirs, mineshafts, industrial plants and possibly unsafe buildings, some of which were strengthened as a result. "Earthquake maneuvers" were widely practiced, including hospital drills and evacuation practice. "Earthquakes were taken out of the realm of mythology and given scientific basis," says Press, "in what must have been thousands of nightly lectures all over the province."

The precursors grew following the shock, including level changes in 70 percent of the 81 wells being monitored. In mid-January, the prediction was narrowed to the first half of the year, with an expected magnitude of 5.5 to 6.0. On Feb. 1, a few small tremors appeared in a previously aseismic region near one of the stations, and by Feb. 3 the number had grown to more than 500.

The big quake was declared imminent. The public was notified to build simple outdoor shelters, to move patients from hospitals and to make suitable arrangements for the old and the weak. Medical teams and rescue brigades were organized, and transport vehicles were removed from their garages to the open air. Outdoor movies were shown to get people out of their houses (despite a temperature of −24°C), with further urging from armed military street patrols. The final evacuation order was given at 2 p.m. on Feb. 4. The quake struck at 7:36.

Chinese society differs from ours, and experience there may not be directly transferable, Press told the recent meeting of the American Geophysical Union, of which he is president. But the message is clear: Planning pays off. □

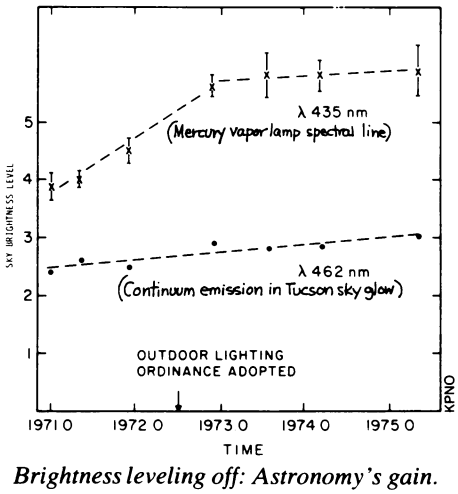
Light pollution: Law cuts sky glare

Back around 1970 the staffs of the many observatories in the southern Arizona mountains were becoming concerned about what astronomers call light pollution. The same urban sprawl that bothers lovers of the fragile desert ecology was bringing city lights closer to their mountains, and the upward glare was beginning to hamper their observations. Before things got really bad, they wanted to see if they could stop the trend.

Monitoring indicated that Tucson's night brightness was increasing by about 10 percent a year. Although seeing conditions at the observatories were still fairly ideal in 1970, if the trend continued, the city's glare would double in 10 years, and that could be purgatory for the astronomers. In 1972 they persuaded the city to adopt an ordinance regulating outdoor lighting.

Monitoring since the adoption of the ordinance shows a significant slowing of the growth of the city's sky brightness. The change is especially dramatic at the wavelength emitted by mercury vapor lamps, one of the chief kinds of outdoor lighting. The lines of mercury vapor wavelengths from street lights can show up in the spectrograms of celestial objects, impairing and sometimes falsifying their interpretation. Kitt Peak National Observatory astronomer A. A. Hoag will report details of the follow-up in a forthcoming issue of PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC.

Tucson's ordinance requires that new outdoor lighting must be directed only



Brightness leveling off: Astronomy's gain.

where it is useful and it must be filtered to limit the color output to the range useful to the eye. Use of advertising and recreational lighting is curtailed between midnight and sunrise. Success of the Tucson ordinance has led to adoption of similar ordinances in other observatory centers. They are Pima County (which surrounds Tucson and includes suburbs not within the city's corporate limits), Coconino County, Ariz. (which surrounds Flagstaff), Hawaii County, Hawaii (the big island where observatories are located and being built), and Richland, Wash. If the trend spreads, perhaps not only astronomers but also ordinary citizens will be helped to a clear view of the night sky, which is now almost invisible from urban areas. □

Forest frogs with ears tuned by sex

Hamilton/Cornell Univ.

Coqui: 'Co' for territory, 'qui' for sex.

One can only guess at such things, of course, but it seems unlikely that many persons would spend hundreds of hours crawling through the undergrowth in a mountain rain forest in pursuit of knowledge. It seems unlikelier still that many would do so in order to play recorded sounds to small Puerto Rican frogs. This, however, is precisely what a Cornell University graduate student did. And his bizarre pursuit paid off: He reported the first known example of a vertebrate with ears "tuned" differently in the two sexes.

Peter M. Narins, a bioengineering doctoral candidate, and Robert R. Capranica, his major professor, report this "sensory sexual dimorphism" in the April 23 SCIENCE. They found, both through behavioral testing in the rain forest and electrophysiological tests in the laboratory, that the coqui frog *(Eleutherodactylus coqui)* of Puerto Rico's high-altitude rain forest has a specially tuned auditory system. The males emit a two-note call ("co-qui") for hours every evening. The "co" part of the call, the team found, is heard preferentially by other males, and tells them, in essence, "Male here! Approach my territory at your own risk!" The "qui" part, on the other hand, is heard preferentially by females, and tells them, "Sexually mature and interested male, this way!"

Narins played a series of tape-recorded natural and synthetic sounds (natural "co-qui's" and individual, synthetic "co's" and "qui's") to males in nature. "I was trying to answer a basic question in auditory physiology," Narins told SCIENCE NEWS. "Does the ear act as a filter for sequential notes? We know that the frog ear acts as a filter for specific *frequencies*, but does it also act as a processor for information that comes in a sequence?" Narins chose the shortest series he could find—the coqui's two-note