testing potential carcinogens with human cells. William Thilly's group at MIT report they have recently successfully tested compounds for mutagenic activity in cultures of human cells. They used a strain of human lymphoblasts (derived from white blood cells) that contain 46 chromosomes, the normal number for human cells. The lymphoblast test is still in a developmental stage compared with the standardized bacterial assay, according to researcher Bruce Penman.

Penman compared some characteristics of the lymphoblast and bacterial tests. Primarily the researchers believe that information they obtained from the human cells will show more accurately what happens in the human body than does the bacterial test. The lymphoblast test is quantitative, so that different compounds can be compared for their ability to cause mutation, Penman noted. Researchers usually use the bacterial test only qualitatively. On the other hand, each test with human cells takes about a month, compared with the few days required for a bacterial test. However, animal tests can take years.

In the lymphoblast assay, researchers determine whether the suspected mutagen changes a particular enzyme into an inactive form. Under some culture conditions, only cells that do not have an active enzyme called hypoanthine-guanine phosphoribosyl-transferase (HGPRT) can survive. This enzyme normally reacts with the base guanine, but it can also react with compounds that resemble guanine such as 6-thioguanine. When HGPRT reacts with 6-thioguanine, the 6-thioguanine gets into the DNA and the cell dies. But if the enzyme has been mutated so it is inactive, the 6-thioguanine does not enter the DNA and the cell survives. The test determines whether HGPRT has been mutated to an inactive form by looking for cells that can survive when 6-thioguanine is introduced into the culture. □

The long and short of gas supplies

Natural gas heats roughly half of American homes and fuels 40 percent of the country's industry, yet domestic production of this vital energy source has been allowed to drop nearly 12 percent over the last three years. Still worse, a decline in exploratory drilling has decreased proven reserves so that the United States is now burning gas at twice the rate new sources are being discovered.

A gas shortage has thus been inevitable for years and no one with a passing knowledge of the situation was terribly surprised when this winter's extreme cold suddenly precipitated a crisis. Where to place the blame and what to do in the future, however, are still subjects for much wrangling—though ultimately it has been inaction, resulting from previous argument, that has produced the present emergency.

As winter grew more bitter, gas was diverted at the state level from industry to homes and "essential human services." A national problem then developed in delivering the gas from well-off portions of the country to those hardest hit. Jimmy Carter's first signature as President brought into law an emergency gas bill giving the federal government authority to transfer gas supplies to deal with temporary shortages. Now, the first major legislative battle of the new administration has begun to develop over the President's proposals to stimulate the economy and help those thrown out of work by the gas shortage.

A long-term solution to the problem, however, can rest only on increased drilling, conservation and the search for alternatives to natural gas. That, in turn, focuses attention on the critical question of whether gas companies have been slowing production to drive up prices, or whether prices have been so low that nothing else could drive up production.

Since 1954, the Federal Power Commission has maintained very low ceiling prices on gas sold interstate. As a result, demand has soared while production and rate of drilling have plummeted. Finally, last year, the FPC allowed the so-called "wellhead" price of gas to triple—from 52 cents per thousand cubic feet (Mcf) to $1.42 per Mcf for new gas. But even that boost left the price of interstate gas substantially below the $2.25 that producers could get if they did not trade out of state, and thus avoid FPC control. (One thousand cubic feet of gas will heat the average home for about three days.)

But did the gas companies involved intentionally withhold supplies they had? A very quick survey of five gas fields, prepared for the Department of Interior, has convinced Secretary Cecil Andrus that the question is at least worth a full-scale investigation. The preliminary survey found that the fields contained 225 nonproducing reservoirs of gas but that only 19 reservoirs had been brought into production since 1974, despite companies' promises that many more of the reservoirs would be tapped. For producing reservoirs, the survey team found that an average of production rates for four of the fields was only 58 percent of the "maximum efficient rate." Finally, within individual fields, the survey report concluded that several producing wells had been shut down for no apparent reason.

In a press conference last week, Andrus cautioned that "today isn't a day to point a finger of blame." The preliminary survey, he said, was intended only to see if a wider investigation of the gas companies was needed. However, he did blame previous administrations for not watching production figures more closely. The Interior Department has had authority for more than a year to order companies to increase production rates, Andrus said, but nothing was done until this January.

Again, charges of chicanery, leveled against the gas companies, are nothing new. Conclusions from past confrontations are not clear:

- A 1974 FPC investigation of offshore fields showed that 4.71 trillion cubic feet (Tcf) of proven reserves and an additional 3.27 Tcf of probable reserves were underlying leases that had not yet been brought into production. (U.S. consumption is about 20 Tcf per year. Producing companies replied that 2.8 Tcf were committed to contract or were awaiting installation of pipelines, 1.1 Tcf were still being negotiated, and 0.8 Tcf were presently uneconomical for laying pipe.)
- Critics have charged that in offshore areas leased by the Department of Interior, 9 out of 10 leases are not producing. Gas producers reply that 9 out of 10 wildcat wells are dry holes and that the ratio of productive areas is about what would be expected.
- Estimates of reserves in certain offshore gas fields, made by the American Gas Association, have turned out 37.4 percent lower than those made by the U.S. Geological Survey. The association explains the difference by saying it uses stricter criteria—specifically, an actual production test—which USGS does not require.
- Many homeowners, whose gas bills have sometimes doubled with higher prices and a colder winter, became livid when some gas companies reported fourth-quarter "windfall" profit increases of more than 50 percent, compared with last year. The companies explain that such an increase is built into the present rate structures, and some offer rebates.

For the long-term, new sources for gas must be found, but development of them will also depend on the price people are willing to pay for this clean, convenient fuel. So-called "enhanced recovery" techniques can squeeze new gas out of old fields at a cost of $1.50 to $2.50 per Mcf. By 1985, gas from Alaska may eventually cost $2.50 to $2.75 per Mcf (constant 1975 dollars). Synthetic gas, or gas from shale and biological sources, may run $3 to $4 per Mcf.

The potential is great. Alaska already has 30 Tcf of proven reserves, with an additional 100 to 350 Tcf possible. Offshore reserves are estimated to be between 70 and 230 Tcf. And coal gasification from just 176 specially selected sites could potentially supply 542 Tcf.

But time is crucial. Even in well-established areas, it takes from four to eight years after the first well is drilled for a field to reach peak production. Alaskan gas will probably be transported by a pipeline that will cost more than the Alas-

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kan oil pipeline, yet it is now only in the early planning stages. Technology for competitive production of synthetic gas must pass through another generation of development. And an investigation of ERDA's enhanced recovery program, by the the Comptroller General, found a "lack of an effective management plan."

Meanwhile, in Washington, protagonists of various sides of the problem are deriving cold comfort by repeating, "I told you so." □

Grape products: Virus killers

For many centuries people have regarded grapes and wines as health promoters. For instance, Egyptian warriors mixed wine with water whenever they invaded foreign lands in order to disinfect it. The centenarians of the Caucasus Mountains of the Soviet Union drink red wine freely with their meals and prize it as their elixir of life. Grapes are also among their favorite fruits. And as for the Italians, they claim that grapes and wines help one toward a long and lusty life.

Is there any scientific evidence to support these attitudes? Yes, it appears so. The bactericidal properties of wines have been known for a few years. And now it looks as if grapes and wines can kill viruses as well—at least in the test-tube environment, according to a report in APPLIED AND ENVIRONMENTAL MICROBIOLOGY (32:757) by Jack Konowalchuk and Joan I. Speirs of the Bureau of Microbial Hazards of the Canadian Health and Welfare Agency, Ottawa. The microbiologists believe this to be the first study of the effects of grapes and wine on viruses affecting humans.

In the process of looking for microbial hazards to strawberries and some other fruits and plants, Konowalchuk and Speirs found an opposite effect—that such fruits and plants contain tannic acid, gallic acid, vanillin and some other compounds with antiviral activity. This surprising discovery then led them to see whether grapes and grape products—grape juice, raisins and wines—might also contain antiviral potency.

After growing human disease-causing viruses such as polio virus and herpes simplex virus in cell cultures, they purchased grapes, raisins and grape juice from local grocery stores and wines from local outlets of the Ontario Liquor Control Board, prepared extracts from the skins and pulps of the grapes and made infusions (clear liquids) from the raisins. The viruses were then placed in bottles containing grape extracts, raisin infusions, grape juice or wines. The cultures were shaken to allow adsorption of viruses, then incubated.

Konowalchuk and Speirs report that grapes, grape juice, raisins and wines indeed showed antiviral activity in the test tube. Grapes and grape juice were the strongest viral killers. Varying degrees of antiviral ability were also found in each of the other grape products.

For instance, viral inactivation among grape extracts was found to come mostly from grape skin, little from the pulps. Grape juice was more active against poliovirus and herpes simplex virus, the causes of polio and herpes infections respectively, than against coxsackievirus and echovirus, responsible for meningitis, fever, respiratory disease and diarrhea. In all instances, red wines killed viruses better than white wines did, and wines appeared to be more effective against herpes simplex virus, poliovirus and reovirus (an apparent cause of meningitis, mild fever and diarrhea) than against coxsackievirus and echovirus. In still another experiment, gelatin was added to virus-grape-juice complexes, and the gelatin reversed the inactivation of the viruses, but only to a point.

Since chemicals known as naturally polymerized phenols appear to provide the antibacterial property of wines, probably by binding to bacterial proteins, Konowalchuk and Speirs believe that these chemicals may also provide the antiviral activity in grapes and grape products by binding to viral proteins. With such binding, viruses might lose their infectivity. Indeed, phenols have been found in abundance in the skins of grapes, the part of grapes that contains most antiviral activity, have been identified in grape juice, and have been observed in large amounts in red wines but in lesser amounts in white wines. The lower phenolic content of white wines is probably the result of the method of preparation, since most white wines are produced from juice only, and red wines are made by fermentation in the presence of grape solids. The total phenolic measurements of white grapes, in contrast, compare favorably with those of red grapes.

Since the antiviral section of grapes and grape products were only shown at the test-tube level, Konowalchuk and Speirs caution that the results cannot yet be extrapolated to the human situation—that is, prove that grapes and grape products protect people against viral diseases. However, they will next attempt to see whether grapes and grape products protect experimental animals against such diseases.

This research was funded by the Canadian federal government and was in no way connected with the grapes, grape juice, raisins or wine industries, Konowalchuk told SCIENCE NEWS. □

Dating the Salton Sea Petroglyphs

Petroglyphs, carvings of figures and designs into stone, often provide curious insights into the cultures of the past. But when petroglyphs are found alone or without any apparent link to other datable artifacts, discovering their origin and purpose can be frustrating. Some dating of glyphs found in arid environments can be accomplished by measuring the amount of patination, the thickness of the patina oxides covering the stone after years of exposure. Another method, ethnographic dating, takes into account artistic styles and other historical data known about ancient cultures which might point to a possible date. These and other methods have tended to be somewhat imprecise and subject to differing opinions.

Two researchers in California have now been able to date with radiocarbon methods petroglyphs found in the Salton Sea area of California. The glyphs, which appear to be geometric designs, were carved into tufa, a calcium carbonate deposited on granitic rock by blue-green algae when the rock was submerged under water. The presence of the carbon allowed Wilson G. Turner of Rio Hondo College in Whittier and Robert Reynolds of the San Bernardino County Museum to subject the glyphs to radiocarbon dating analysis. Their results have recently been published in *Indian Rock Art in Southern California*, edited by Turner and Gerald A. Smith, the director of the San Bernardino County Museum.

Turner and Reynolds took a microscopic cross section of the tufa under the glyphs and found seven distinct layers of tufa formations, indicating the rock had been exposed to seven separate inundations of water and dry periods when the sea or lake in the area successively rose and fell. The glyphs were incised into the tufa between the fifth and sixth layers, apparently during one of the dry periods. By dating the layers above and below the glyphs, the researchers were able to estimate a date. The fifth layer was dated as 9,180 ± 135 years old and the sixth as 9,030 ± 135 years old. Interpolating between these bracket dates, the researchers dated the glyphs as 9,100 years old.

Although the glyphs have now been accurately dated, the frustration and confusion are by no means over. The random order of the geometric designs and the absence of any pictorial or figural elements provide no clue to their significance. The drawings might have been graffiti from passing travelers or esoteric symbols of an ancient religious rite. In addition, the glyphs are much older than any previously dated glyphs in the area. Finally, the glyphs do not appear to be related to any known people at that time. Turner and Reynolds are now searching for other clues such as trails or other glyphs to connect the Salton Sea glyphs with other evidence. □