clear deterrent" of putting them out of business; hence, the interim standards compromise.

Ruckelshaus vehemently denied White House pressure in coming to his decision, saying rather that he was following the court's injunction to take social and economic risk factors into account. He also emphasized that by applying stricter standards first to California, where Japanese carmakers concentrate their sales, the battle between catalysts and the Japanese-produced stratified charge engines could be fought in an open, competitive marketplace.

Upon the outcome of that and other looming battles may depend not only the future of America's air, but millions of jobs and an industry whose activity constitutes roughly one-fifth the national economy. □

Illustrations: Richard Zare

Zare (r) and colleagues with their detector: "A powerful new analytical tool."

Where energy goes when chemicals react

For years chemists have yearned to know what really happens when chemical molecules react to form a new product. Molecular beam scattering techniques are bringing them closer to their ambition.

One of the first molecular beam scattering techniques projected beams of two kinds of chemical molecules so that the molecules interacted. But the compounds formed were scattered thinly into all angles, so the internal energy—vibrational or rotational levels—of the products could not be determined. For example, when potassium was made to interact with iodine, the salt formed could be distinguished from the potassium by the use of hot wire detectors. The detectors determined the angular distribution of the salt molecules, but did not show their vibrations and rotations. The detectors were also limited to reactions between atoms and molecules with extremely low potentials for ionization: alkalies like potassium and halogenated compounds like iodides.

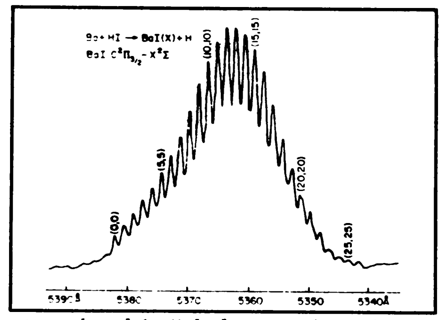
Then electron ionization and mass spectrometry arrived as an adjunct to molecular beam scattering. The angular distribution of all types of chemical products, including organic molecules, could be detected. But this technique was, and still is, handicapped by the low efficiency of the electron bombardment ionizer. This means that background gases as well as product molecules are ionized, and the gas ions can interfere with the detection of the angular distribution of the product molecules. What's more, the technique does not give the vibrations and rotations of the molecules.

Now, after two years of work, Richard Zare and his team of physical chemists at Columbia University have devised what appears to be the most sensitive and widely applicable molecular beam scattering technique yet for measuring energy output during chemical reactions. The technique gives not just angular distribution but also the internal energy of the reaction product following a reaction encounter, which takes no more than one-trillionth of a second.

In reporting the technique at the national meeting of the American Chemical Society in Dallas last week, Zare declared: "We have an immensely powerful new analytical tool which might be likened to an ultraselective analytical balance. As we can detect as few as 10,000 molecules in a given vibrational or rotational level, this corresponds to a weight of a billion billionth of a gram."

The chemists use a laser beam as a molecular beam detector. The laser's beam of sharp and intense light is focused on a chemical product right after it is formed. The energy in this high-powered beam induces the molecules in the product into an electronically excited state. Because the electrons in the molecules are excited, the molecules fluoresce, or "shine." The strength of the fluorescence of the excited product molecules is then measured as a function of laser wavelength. Patterns of fluorescence at different stages of excitation are printed out as a line of so many peaks and troughs. The peaks represent the concentration of the product molecules in a particular vibration or rotational level.

Zare and his colleagues have found how much energy goes into the vibrations and rotations—"shaking and quaking," as he puts it—of product molecules. "We can calculate directly," he says, "how the excess energy of reaction goes into vibration and rotation, and from this a picture emerges of



A molecule's "shaking and quaking."

how the reaction occurred. We learn whether reactants had to climb a hill to form a product, or whether they did not."

In an interview, Zare observed: "Laser-induced fluorescence is helping us realize the chemist's dream of understanding how energy flows to break old bonds and to form new ones. Such detailed knowledge should help us modify reaction conditions to make new products, or to increase the yield of products already of value to society. Laser-induced fluorescence may also clarify interactions among environmental pollutants, or among molecules in living organisms." □

NIH bans research on live fetuses

In a much-debated move last week the National Institutes of Health banned experimentation with live human fetuses. For almost two years NIH officials have been considering adopting guidelines that would have allowed such research only on nonviable fetuses, those that could not possibly develop into full-term babies. Standards for experimentation would have allowed the use of live fetuses aborted before the 20th week, less than 1.1 pounds in weight and shorter than 9.8 inches.

When it was publicly revealed that

Quake prediction 'on verge of reality;' geophysicists seek other links

"Earthquake prediction, an old and elusive goal of seismologists and astrologers alike, appears to be on the verge of practical reality." This was the report of three researchers from Columbia University's Lamont-Doherty Geological Observatory, and at the multitudinous annual meeting of the American Geophysical Union in Washington this week, predictions and correlations are, in large measure, the name of the game.

New understanding of the convoluted relationships that link the physical characteristics of the earth (and other worlds) is the goal of the AGU's members, who run the professional gamut from meteorology to volcanology, from oceanography to astrophysics.

Often the connections they find are strange indeed, as in the case of two University of Hawaii scientists who have found that the upper atmosphere may offer advance warnings about tidal waves, or tsunami. The tremors that can produce tsunami also generate vertically polarized waves in the earth called Rayleigh waves. These vibrations pass on to the air and move upward through the ionosphere, where, according to Kazutoshi Najita and Paul Yuen, they can be detected by the ionosphere's corresponding effect on radio waves.

Another investigator theorizes a connection, in the eastern United States at least, between quake-prone areas and low surface elevations. "Either the crust is weaker and breaks more easily where it is thinner," says Benjamin F. Howell Jr. of Pennsylvania State University, "or it erodes more easily where it has been broken in the past, and the low places mark these weaknesses."

The Lamont-Doherty team—Christopher H. Scholz, Lynn R. Sykes and Yash Pal Aggarwal—believe that quake conditions can begin when subterranean rocks crack, releasing the pressure which has been delaying the quake by holding the region stable. As water from adjacent regions seeps in, the pressure rises again until it triggers a quake within the now-fragmented rock. The build-up to a quake has detectable symptoms, however, which could be the key to prediction: small uplifts on the surface, changes in electrical conductivity as the water flows in, increased emission of radioactive radon gas and a decrease in small tremors as the water lubricates the rocks while the pressure is building. All these symptoms have been observed preceding at least 30 quakes in Japan, the Soviet Union and the United States.

Several AGU attendees also discussed the work of a colleague, not reporting at the meeting, who reportedly found such a strong correlation between local increases in the earth's magnetic field and subsequent tremors around California's San Andreas Fault that he took several months for additional observations to make sure.

Not all such connections, of course, are studied with natural disasters in mind, although those links, too, may be present. Perhaps the broadest theory was one presented by Moody L. Coffman of Central State University in Oklahoma, relating changes in the earth's main magnetic field not only to earthquakes, but to volcanic eruptions, tidal motions and continental drift.

Practical or theoretical, the work of the predictors and correlators points to a unified picture of earth.

such a move was being considered, NIH officials avoided any possible controversy and made a final decision. At a demonstration by Roman Catholic schoolgirls an NIH spokesman stated: "We know of no circumstances at present or in the forseeable future which would justify NIH support of research on live aborted human fetuses." The unofficial statement is expected to become policy. This position will not affect private research but because of the pervasiveness of NIH funding, it is expected that all such experimentation in the United States will be discontinued.

Those who favor research on live human 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 and other environmental agents can be seen in the entire organism rather than in cell cultures or single organs. Such work, researchers hope, will eventually clarify the dangers or benefits to the fetus of drugs taken by the mother during various stages of pregnancy. With the new NIH position, however, such research will have to be done out of the country and without NIH funds. □

Don't go near the (drinking) water

If air pollutants don't suffocate you or food additives poison you, drinking water laced with a little arsenic or cadmium may well do the trick. This was some of the less encouraging news to emerge from last week's meeting of the American Chemical Society in Dallas.

Various investigators have noted strong correlations between soft water and heart disease (SN: 2/10/73, p. 89). There is fairly strong evidence that lithium, and perhaps also vanadium, barium and strontium in soft water are the hazardous chemicals, Julian B. Andelman of the University of Pittsburgh reports. Harold W. Wolf of the Water Reclamation Research Center in Dallas has found that deaths from heart disease increased when salt water, high in sodium, was processed into drinking water. Sodium has long been implicated in heart disease. Walter J. Weber of the University of Michigan has found that soft water is more apt to contain cadmium than is hard water. Because cadmium accumulates in biological tissues and may replace zinc in certain proteins, its presence in the human body is probably undesirable. But there is no specific evidence that cadmium is implicated in heart disease.

Clinical and epidemiological studies in several locations throughout the world have shown adverse health effects from arsenic in drinking water, Gordon Robeck of the Environmental Protection Agency in Cincinnati points out. In Taiwan people who use well water rich in arsenic develop hyperpigmentation and eventually skin cancer. Well water on a Nevada ranch that was high in arsenic content caused skin conditions in one child and possibly in another. Wolf has noted a "striking" correlation between the presence of heavy chemicals in water basins throughout the United States and the incidence of bladder cancer. This is one kind of cancer scientists are sure is triggered by environmental chemicals.

On the whole, investigators are far from certain what effects chemicals in drinking water have on health. The health effects themselves are difficult to determine, and the chemicals in drinking water are ever-changing. As Andelman stresses, chemicals put into drinking water at the time of treatment, such as chlorine and aluminum, often dissipate by the time they reach the tap. On the other hand, water may pick up new chemicals, such as cadmium, copper, nickel and lead, after it leaves the treatment plant. Water from treatment systems near each other may differ in chemical content. Water processed from the Allegheny and Mo-