

The higher reaction rate between nitric oxide and hydroperoxyl radicals better fits observations in experimental smog chambers, Howard relates.

Laboratory experiments using the laser magnetic resonance technique may soon update other reaction rates. Howard predicts that his method will be applicable to "a tremendously long shopping list of hydroperoxyl reactions" that are now assumed to be slow.

"This high rate constant is a head-kicking effect, it completely changes predictions," Howard said in an interview. "But things can still change. We are learning at a rapid rate and expect major uncertainties. If we need to make long-term decisions, we need to use the best scientific evidence available." □

Academic science: Quality decaying

A two-year-long study concludes that while American academic science still enjoys a position of world preeminence, "sufficient warning signs of emerging problems have arisen to alert policy-makers to ensure these downward trends do not worsen." The 264-page report, based on interviews with scientists, deans and graduate students at 36 universities and numerous government officials, makes no specific recommendations for remedial action. It was sponsored by the National Science Foundation and published by Change Magazine Press.

Reacting to the report, Sen. Daniel P. Moynihan (D-N.Y.) said, "In the years since World War II, the United States developed the world's premier scientific research enterprise, primarily because of an extraordinary and mutually beneficial partnership between the national government and the great public and private universities. No public policy issue today is more compelling . . . than the future of that relationship."

Authors Bruce L. R. Smith of Columbia University and Joseph J. Karlesky of Franklin and Marshall College conclude that a decrease in federal and state funding of university research has provoked tension between all the parties involved: government officials, university faculty, graduate students and administration. The authors express concern that a greater share of an already dwindling R&D budget in the United States—decreasing from about 3 to 2.4 percent of the gross national product during the past decade—is being invested in the work of a smaller group of "elite" universities. This is causing a widening breach between the few well-financed and well-equipped research institutions and the great majority of others, which are not being as generously supported. Consequently, many universities may find it ultimately necessary to curtail certain educational and research programs due to lack of funds. □

Cytomegalovirus: The newborn's enemy

Cytomegalovirus infection, particularly of the genital tract, is common among American women. If present when a woman gives birth, the virus may not only infect her offspring but also damage its brain. Some 3,700 American newborns are mentally impaired each year from congenital cytomegalovirus infection. Thus, medical researchers would like to prevent this major public health problem by vaccinating women of childbearing age against the virus.

Before vaccination can become clinically available, however, scientists need to learn more about the infection in pregnant women and their progeny and particularly about the role of maternal and fetal immunity to it. A vital contribution toward this end is reported in the June 2 *NEW ENGLAND JOURNAL OF MEDICINE* by Sergio Stagno of the University of Alabama Medical Center in Birmingham and his pediatric and microbiology colleagues.

Stagno and co-workers examined levels of antibody against the virus in the blood of 239 pregnant women. They found that 208 out of 239 (82 percent) showed antibodies against the virus, indicating that they had been infected with it at some time or another. This result confirmed previous findings—that cytomegalovirus is indeed rampant among American women.

A more crucial finding came next. The women who had antibody immunity against the virus during pregnancy were still able to give birth to cytomegalovirus-infected infants. Seven of the 208 immune women's infants (3.4 percent) were infected, compared to 3 of 31 women (10 percent) without antibodies. In other words, maternal antibodies may provide only limited fetal protection against infection, if any, suggesting that vaccinating women against the virus might not shield their offspring.

None of the infected infants born to women with antibodies were mentally retarded, however. They eventually recovered from the virus infection. Thus, while vaccination (antibody immunity) may not protect newborns from cytomegalovirus infection, it might still safeguard them from viral damage.

Other valuable information has also come from the study by Stagno and his colleagues. Not only primary cytomegalovirus infections but also recurrent infections can infect women and harm their offspring. In fact, the results suggest that recurrent infections may pose even more of a danger than a primary one. Such viral behavior stands in stark contrast to other microbes that infect fetuses almost exclusively as a result of primary maternal infection. Stagno and his co-workers believe that these data demand that viruses to be used in the vaccines prevent primary maternal infection or reduce the chances for transmission to the fetus or subsequent

infection. (Live cytomegalovirus vaccine trials are already underway in England and Switzerland and are being considered in the United States as well.)

In spite of the insights provided by this study, some crucial questions about cytomegalovirus infection and damage of offspring press for answers. This is emphasized by Donald N. Medearis Jr. of Cleveland Metropolitan General Hospital in an editorial in the same *NEW ENGLAND JOURNAL OF MEDICINE* issue. For one, what is the role of cellular immunity (immunity provided by white cells known as T cells) in cytomegalovirus infections? A 1975 study suggested that mothers who give birth to congenitally infected infants have a specific impairment of cellular immunity. However, cellular immunity has not yet been studied in mothers and infants to determine whether it might protect against either congenital infection or mental retardation.

Also to be studied is whether an offspring can only be infected during birth or whether it can also be infected in the womb. For the first three months of life, a fetus has few antibodies of its own, and because two other microorganisms—rubella (German measles) and toxoplasmosis—can damage a fetus during the first trimester in the womb, cytomegalovirus may be able to do so, too. □

Unprovable problem in arithmetic

One of the most profound achievements of 20th century mathematics was the proof given by Kurt Gödel in 1931 that the axioms of elementary arithmetic are incomplete: There will always be true statements of arithmetic that cannot be proved from the axioms. Gödel's discovery meant that, in principle, some of the famous unsolved problems of mathematics might be so not just because they are difficult, but because they are theoretically undecidable. Unfortunately, the only examples of undecidable propositions produced by Gödel's method—or in the 35 years since his proof—are exotic statements created solely for the purpose of exhibiting an example.

Last month Jeffery Paris at the University of Manchester proved for the first time that one of the important unsolved problems of arithmetic is really undecidable. He showed that a certain rather famous conjecture concerning the numbers of ways objects can be arranged in patterns cannot be proved from the axioms of elementary arithmetic. Perhaps more surprising, this conjecture is known to be true—by virtue of reasoning with infinite sets that lie outside the purview of elementary arithmetic.

The proposition that Paris proved undecidable concerns numbers called Ramsey numbers—after the British mathematician and economist Frank Ramsey—that count patterns of interactions between members of a finite set. The most elementary of the Ramsey numbers concern, for instance, the numbers of ways in which people at a party can be introduced to each other. The Ramsey numbers grow very large very quickly, so rapidly in fact that they outstrip the power of the axioms of arithmetic to keep pace with them. Paris showed that the existence of certain Ramsey numbers could not be deduced from the standard axioms of arithmetic, even though their existence is guaranteed by more sophisticated reasoning dealing with infinite Ramsey numbers.

Paris's proof used methods of model theory and nonstandard analysis (SN: 2/15/75, p. 108). He discovered an atypical model for the axioms of arithmetic in which the Ramsey conjecture was false. If the Ramsey conjecture were deducible from the axioms of elementary arithmetic, then it would have to be true in every model of arithmetic. Since, as Paris showed, there is at least one model in which it is false, it cannot be provable. Yet in the ordinary model for arithmetic—that studied in school mathematics—the Ramsey conjecture is true.

There are many famous unsolved problems in arithmetic. One of the more famous is the twin prime conjecture that there are infinitely many pairs of prime numbers separated by 2, such as 17, 19; or 41, 43. The undecidability of the Ramsey conjecture makes it now likely that some of these old chestnuts may also be proved undecidable, for it may be easier to relate them to the Ramsey problem—since they both involve numbers—than directly to the axioms of arithmetic or the precepts of logic. □

Viking biology off

The biology instruments aboard the two Viking landers on Mars, the first devices ever sent to seek signs of life on another planet, have at last been turned off. The two packages operated from July 28 to May 30 and from Sept. 11 to May 28, although scientists are still studying the results. Other lander experiments continue.

The biology instruments may be reactivated, however. Viking's inorganic-chemistry team wants the radioactivity counters in the pyrolytic-release experiments to monitor background radiation from the landers' nuclear power plants. The organic-chemistry team, meanwhile, plans to pour a heavy dose of nutrient solution onto a soil sample in the gas-exchange instrument in hopes that the water in the solution would reveal, by exothermic reaction, the possible presence of magnesium sulfate in the soil. □

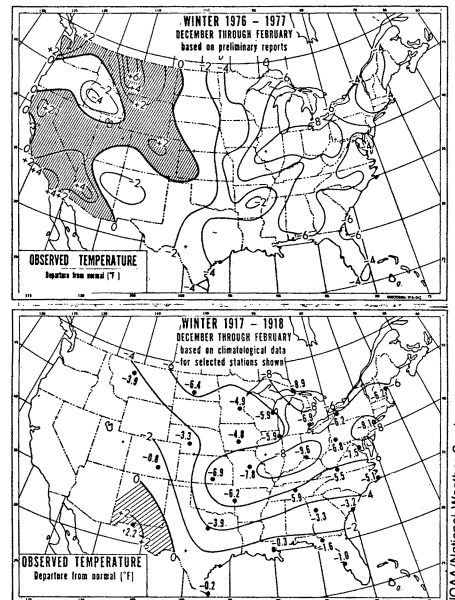
Severe winters: Search for precursors

Some consolation to the millions of Americans victimized by this year's winter may be that studies of it have provided a better means to anticipate another like it. Meteorologist A. James Wagner has confirmed that the calamitous winter was in part caused by an abnormally high pressure cell above the Arctic. Its persistence further aggravated the devastating effects.

Together with this polar high, an anomalous global pressure pattern conspired to directly channel this frigid Arctic air to eastern North America. This phenomenon attained its greatest ferocity during January 1977, when record snow falls and low temperatures were experienced throughout eastern and southern United States.

Ironically, this same weird combination of pressure highs and lows caused the hot, dry weather over western United States, including Alaska, many parts of which recorded unprecedented mild winters. With similar consequences, warm Atlantic air was rerouted unusually northward and then westward across northern Canada. And to cap off this enormous incongruity, the Arctic was warmed due to the high-pressure cell stationed there.

But some good may come from those three months of agony. Wagner, of the National Oceanic and Atmospheric Administration, searched this century's weather records and discovered another winter, of 1917-1918, that bears a striking resemblance in severity to this year's. The similarities (see diagram) may be enough, Wagner believes, to teach us how better



Two most severe winters of 20th century.

to anticipate another harsh winter. He cautions, however, that present understanding does not yet allow forecasts with certainty. Among other things, Wagner found that the two acute winters were each preceded by an unusually cold fall season throughout eastern and southern United States. Furthermore, each was presaged by the appearance of an "unusually persistent large body of colder-than-normal water in the north-central Pacific." Even though their operation and significance are not yet fully understood, these precursors will put the forecaster on alert to future severe winters. □

Drinking water safe? Needs research

The bad news on drinking water isn't all that bad, but it isn't good news either. Repeatedly, the final report of the National Research Council Committee on Safe Drinking Water identifies questions where insufficient data preclude reliable judgments. The 18-month study was undertaken to aid the federal officials responsible for establishing water standards. About one hundred scientists helped examine evidence of adverse effects for 161 different elements and compounds present, or likely to be present, in drinking water.

Some of the conclusions:

- Most of the inorganic chemicals considered are of little or no threat to human health. However, current standards for arsenic and lead afford only "meager" margins of safety and should be reexamined.

- The present limit on nitrate concentration in water leaves little margin of safety for avoiding the blood disease methemoglobinemia in some infants. On the other hand, current scientific evidence

does not indicate that nitrate in water increases risk of cancer.

- Available evidence does not support claims that fluoridation increases cancer mortality, mongolism or birth defects. The only clear effects of water fluoridation, besides the decrease in dental cavities, is discoloration of tooth enamel and increased bone density, effects not generally considered harmful.

- Chlorination of water has had unparalleled success in controlling waterborne infectious disease, especially typhoid fever. This clear benefit must be considered against the risk that chlorine may form suspected carcinogens in water. The committee concludes "much more research is required before any of the proposed substitutes can be recommended to replace it [chlorine] in water treatment."

- The study calls "plausible" the hypothesis that hard water (high in calcium and magnesium) decreases risk of heart disease, hypertension and strokes. If that hypothesis holds, optimal condition-