NAS study backs pollution limits

A one-year study on the health and cost effects of air pollution, conducted by the National Academy of Sciences for the Senate Public Works Committee, concludes that present ambient air quality standards are generally supported by research conducted since they were first set up. However, the NAS scientists warn that large uncertainties still exist as to how much health damage is caused by pollution, and that much more extensive studies are needed.

The study concentrated on the effects of auto emissions. The NAS panel concluded that such emissions may account for as much as one quarter of one percent of the total urban health hazard, causing as many as 4,000 deaths and 4 million workdays lost due to illness, annually. A substantial portion of this effect is due to the extreme susceptibility to pollution of people already suffering respiratory or cardiac ailments. As much as one-fifth of the population, including the very old and very young, may be especially vulnerable to air pollution, the report concludes.

The only major revision of the standards recommended was an unspecified easing of the nitrogen oxides emission standard for automobiles. The present standard may be "somewhat more stringent than is needed" to achieve desired ambient air quality desired for NO_2, except in the Los Angeles area, the panel reported. It recommended more study, however, before trying to set new, lower standards.

Even this mild announcement was welcomed by the Detroit auto industry, which says it can begin work on stratified charge engines (SN: 4/28/73, p. 276) once the nitrogen oxide standards are eased. (Automakers say they have no way of meeting presently projected NO_x standards, since catalytic mufflers only take care of unburned hydrocarbons and carbon monoxide, and even stratified charge engines produce nitrogen oxides above the 1978 limit.

A glance at the details of the academy report shows just how uncertain the business of estimating pollution effects remains. The panel estimated that one percent of the total urban health hazard results from air pollution of all sorts, but they cite other experts whose judgments range from a hundredth of that figure to ten times larger. Similarly, the supposed monetary loss due to adverse health effects of pollution ranges from $500,000 a year to $3 billion. The committee could conclude only that the apparent monetary benefits of less pollution and the apparent costs of emission control lie in the same ballpark (a factor of two or three, one way or the other).

The committee said that the concept of "thresholds"—pollution levels below which *no* effect would be observed—simply is not applicable, since contamination and health effects seem proportional at all levels. "There is no escape from a reasoned judgment, containing an unavoidable subjective element," stated the report. "In this respect, air quality standards do not differ from other standards established by legislation and regulation."

Such an ambiguous, though reasoned, conclusion was the last thing the Senators wanted to hear. Stormed Edmund Muskie (D-Maine): "What we want is some one-armed scientists" who give definite conclusions; not ones who say "on the one hand . . . but on the other hand." Committee chairman Jennings Randolph (D-W. Va.) criticized the academy for concentrating on autos while neglecting study of emissions from stationary sources (which run on West Virginia coal).

Academy President Philip Handler reminded the committee that it had specifically requested information on auto emissions, but not on stationary sources. John Seinfeld, who worked on the committee, defended the report's ambiguity by saying "we really do not know what the effects of a relaxation" of standards might be. Chairman Randolph said he had hoped to have more data on which to base modification of the Clean Air Act next year.

Specifically, the NAS report says more information is needed on how pollutants interact (synergism), how weather patterns affect their spread, and what effect they have on, say, people who smoke, as opposed to those who don't. The study follows close on the heels of a report that a majority of Americans already have carbon monoxide blood levels at or above the safe level recommended by the Clean Air Act (SN: 9/7/74, p. 148). □

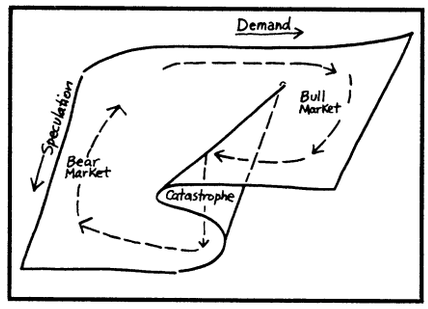
Mathematicians hail new theory

This news report from the International Congress of Mathematicians was written by Lynn Arthur Steen, professor of mathematics at St. Olaf College, Northfield, Minn., under an experimental public understanding of the mathematical sciences project being initiated by the Conference Board of the Mathematical Sciences. Future reports from Steen may appear from time to time in SCIENCE NEWS.

Ever since calculus was invented three centuries ago, mathematicians and scientists have found it to be an indispensable tool in explaining the continuous processes of nature. Until recently, however, they have had no comparable model for discontinuous phenomena such as the boiling of a liquid, the crash of a stock market or the discrimination of different tissues in an embryo. But now they have a very promising model for such things, in the form, roughly, of a carefully crumpled sheet of paper.

Thousands of the world's leading mathematicians, assembled last month at Vancouver, B.C., in their 17th quadrennial international congress, turned out to hear E. Christopher Zeeman of the University of Warwick outline the highlights of a major new theory that has developed in the four years since the congress last met in Nice, France, in 1970. He documented its power by an impressive variety of applications in such diverse fields as linguistics, political theory, embryology, neurology, economics, psychology, sociology and physics.

French topologist René Thom, winner in 1958 of a Fields medal for outstanding contribution to mathematics, created this new theory in a series of papers on topological models in theoretical biology. He called it the theory of "catastrophes" because it explained how a tissue (or other biological object) may suddenly, "catastrophically," jump from one form of behavior to another. The simplest model of catastrophe theory is that of a surface with a smooth pleat: As a particular process such as a bullish stock market climbs smoothly to the upper part of the pleat, it will reach a point where it may fall catastrophically to the lower part whence it may begin its slow climb once again.



An illustration of stock market cycles on a manifold: A bear market with sluggish demand and fleeing speculators is followed by increasing demand, then increased speculation. Once demand begins to fall, this bullish market encounters a catastrophe on the surface, abruptly dropping to a bearish mood.

Because it is based on deep results in differential topology, Thom's work is not yet widely understood. But it is being used by an enthusiastic coterie of pure and applied mathematicians, and has been hailed by reviewers as comparable in its scientific potential to Newton's *Principia* itself. Whereas Newton invented calculus in order to explain the continuous processes of nature,