collecting in the upper troposphere, he says, at a rate approaching the nine percent worldwide increase in production per year. What is not yet known is whether, and to what extent freons are collecting in the stratosphere (the upper atmosphere, above seven miles from the earth's surface), the proposed breakdown site.

Frank S. Rowland and Mario J. Molina, physical chemists at the University of California at Irvine, have proposed a model for freon breakdown and ozone destruction. It is based on a similar reaction between nitrous oxide and ozone in the lower atmosphere. First, they propose, freons in the stratosphere absorb ultraviolet light in the 1,750 to 2,200 angstrom range, and chlorine is liberated. The liberated chlorine atom in turn attacks ozone, breaking it into oxygen. Each chlorine atom can remove thousands of ozone molecules from the stratosphere in this way, Rowland predicts.

Concentrations of fluorocarbons can be expected to reach 10 to 30 times their present levels if production continues to increase at the current nine percent per year. The result would be the destruction of 10 percent of the stratospheric ozone layer within 50 years, Rowland says. He has already calculated a one percent reduction in stratospheric ozone—a reduction that could result in about 8,000 additional cases of skin cancer this year, according to National Academy of Sciences statistics on skin cancer. After 50 years (and 10 percent ozone destruction) that number could be 80,000 per year.

Two physical chemists from the University of Michigan at Ann Arbor will report computer calculations on ozone destruction in the Sept. 27 SCIENCE. Ralph J. Cicerone and Richard S. Stolarski predict that freons will cause a "marked reduction" in stratospheric ozone "exceeding that predicted for a 500-plane SST fleet" by 1985 or 1990. Their model is more pessimistic than Rowland's, predicting the same 10 percent reduction in stratospheric ozone but after much less time and with lower stratospheric fluorocarbon levels.

Potentially more dangerous than the threat of increased skin cancer, Rowland says, is the threat of climatic changes after ozone destruction. "Ozone is the heat source for the stratosphere, and if it is thinned, it allows for more infrared rays (heat) to pass through to the troposphere and thus to shift atmospheric temperatures." Not enough is known about the structure of the stratosphere and its climatic interactions, but heat shifts could cause wind shifts and changing global climatic patterns, he says.

Current methods are inadequate for measuring fluorocarbon concentrations and ozone destruction, Rowland said when challenged for experimental evidence by DuPont chemical company spokesmen during a press conference. (DuPont is the largest U.S. producer of fluorocarbons.) The chemical breakdown sequence is only a model at this time, and Rowland's one percent decrease in stratospheric ozone was calculated by chemical rates and not by observation or direct testing. It is not known, for example, whether fluorine atoms also are photodissociated from freons and destroy ozone. Other ozone-destroying chlorine compounds might also exist in the stratosphere that are not detected with current analytical methods.

But work should not be suspended until new methods are developed, he says. "There is enough information available to persuade us that the eventual risk is large and that all aspects of the problem should be examined on a broad scale." Society must begin to assess the benefits of fluorocarbon aerosols and refrigerants compared with their potential risks to human health and world climates, Rowland says. "My own opinion is that the advantages of the former are not worth the risks of the latter." □

Ford signs solar heating bill

President Gerald R. Ford has signed into law the Solar Heating and Cooling Demonstration Act of 1974, designed to introduce solar energy into American homes and businesses over the next five years. The bill represents a compromise among several different House and Senate versions, arrived at following a year of intense argument over what agency should handle the project and prolonged handwringing over previous failures to exploit so attractive an energy source (SN: 4/13/74, p. 242).

In the final version, the National Aeronautics and Space Administration (NASA) is given responsibility for procuring and developing the necessary technology to heat and cool homes and office buildings at a reasonable price, and the Department of Housing and Urban Development (HUD) is charged with demonstrating the effectiveness of such systems under a variety of conditions. In practice, this means that NASA will try to cut the cost of solar collectors from their present $5.50 a square foot to around $2 a square foot—the cost level considered necessary for solar energy to compete nationally with alternative sources. Developers will also have to concentrate on increasing reliability so that when the units are eventually marketed, companies can guarantee their performance for 10 to 15 years. Meanwhile, HUD will subsidize the installation and testing of trial units on private homes and other buildings throughout the country. The National Bureau of Standards will work with HUD to develop performance standards and testing procedures.

Congress has authorized $60 million for the five-year project, which does not affect ongoing basic research on solar energy being conducted by the National Science Foundation. A separate bill, to give as much as a billion dollars for research and development of solar energy over the next five years, passed the Senate this week. A recent study sponsored by NSF indicated that if the federal Government would undertake an initial incentive program, private industry would rapidly show increased interest. With such participation, the study concluded, by the year 2000, some 4 million buildings may be solar equipped (SN: 6/29/74, p. 412). Until now, the solar industry has been dominated by small entrepreneurs using highly experimental designs, while major companies have taken a "wait and see" attitude (SN: 2/2/74, p. 69).

The two lead agencies are now expected to draw up a tentative working plan, which they will submit to the Congress within four months, together with requests for specific appropriations. Since simple heating systems have progressed further toward marketability than the more involved heating-cooling systems, the time-scales proposed for the two projects are expected to be substantially different. Other agencies are also expected to become involved in the effort. The Department of Defense, for example, is expected to work with HUD on installing solar units on military bases.

Besides working out the technical bugs in present solar systems, the five-year demonstration project is designed to boost public acceptance of solar energy. In part this will be accomplished simply by distributing working models around the country, so that soon the average American will personally have seen solar energy in action (supposedly, people are most conservative when it comes to buying homes, and the home building industry fears the acceptability of "unsightly" solar collectors). A more subtle problem will be changing the current financing arrangements that put solar systems at a disadvantage because of their large initial cost. A major educational program will aim at introducing the concept of "life-cycle" costs, which will show homeowners that solar systems theoretically increase the resale value of their houses. □