Airplanes and Cancer: A New Jet Needed

Jet engines are so capable of damage to the earth's protective ozone layer that completely redesigning them will probably be necessary. Without this redesigning, or the strict limitation of fleet sizes, many more persons will contract and die of skin cancer each year.

These cheerless predictions are contained in a report of the National Research Council's Climatic Impact Committee, just released. The report comes as a contradiction, at least in spirit, to another report on the impact of stratospheric flight released by the Department of Transportation in late January. Both studies were begun after Congress deferred the development of a U.S. SST fleet in 1971, based on early suspicions of ozone destruction by jet engine exhausts. The DOT study assigned numbers to the probable ozone depletion that were a factor of two smaller than the current NRC study, and many interpreted the DOT study as an exoneration of stratospheric flight. But both studies, conducted by experts in the fields of atmospheric science, aeronautics, biology and medicine, confirm the earlier theory that the ozone layer is being depleted and call for a redesign of jet engines if passenger plane fleet sizes are to be increased over the next two decades.

The problem arises because jet engines emit certain combustion products into the ozone layer in the stratosphere. The jet combustion products, nitric oxide (NO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and sulfur trioxide (SO_3), affect the stratosphere in two ways. The nitrogen compounds react with ozone molecules, catalyze their breakdown into molecular oxygen and allow more ultraviolet light to reach the earth. The sulfur compounds form particles which can block out some of the beneficial solar radiation and may affect climate and agriculture.

NRC panel member Frederick D. Rossini said at a press conference this week that the nitrogen compounds are formed at very high temperatures in the engines, above 1800 degrees K. The engines could be redesigned to burn at lower temperatures, he says, to reduce the emission of nitrogen compounds. The sulfur oxides are formed with sulfur contaminants in jet fuel and these could be removed during petroleum cracking, Rossini says.

The effect of airliners on stratospheric ozone has been small so far, less than a one percent reduction, but could get much greater, the report states.

The addition of 100 present-day supersonic airliners (like the Anglo-French Concorde or the Soviet TU-144) would decrease the ozone by 0.7 percent and increase skin cancer by 1.4 percent per year. That would mean about three new cases of skin cancer per year per 100,000 Americans. A fleet of 300 to 400 of the larger supersonic airliners (the type deferred by Congress) would have caused about a 10 percent reduction in ozone and a 20 percent increase in skin cancer cases per year.

J. Weinberg

Booker, (right) and NRC *committee members present tough recommendations at a press conference this week.*

These ozone depletion figures are separate from estimated depletions due to aerosol propellants and other halogenated hydrocarbons. With unlimited growth of SST fleets (with current engine design) and unlimited growth in the use of aerosol propellants, study chairman Henry G. Booker of the University of California at San Diego says, there could be a 40 to 60 percent decrease in the ozone layer by the year 2000, with disastrous consequences for human health, agriculture and climate.

The NRC Climatic Impact Committee recommends several actions to avert the possible damage by jet exhausts. (They are currently studying aerosol propellants.) A large research and development program, costing perhaps $100 million, should be devoted to creating jet engines with reduced nitrogen oxide emissions. Research at the NASA laboratory in Cleveland, New York University and elsewhere has already produced experimental fuel-injection systems that reduce emissions by a factor of 10 or more. Another recommendation is the removal of sulfur from jet fuels. The committee also calls for international cooperation in setting strict emission standards for aircraft and monitoring the effects. The international effort could be coordinated by the International Civil Aviation Organization, they state, and emission standards and monitoring could be the responsibility of the World Meteorological Organization. The committee also recommends additional research in several areas: the cause of skin cancer, the mixing of atmospheric layers and basic atmospheric chemical reactions, and the biological effects of stratospheric modification. □

NSB: Science's solemn prospect

The current American research effort, according to the annual report of the National Science Board, is "inadequate to prepare the nation for the challenges which are now emerging." Between 1970 and 1974, the board noted, total funding of basic research from both public and private sources decreased 10 percent in constant dollars, with Federal outlays declining 15 percent. In addition, the supply of scientists needed to fill positions in two of the fastest growing fields—cancer and energy research—is already inadequate and likely to get worse, concludes the report.

Each year, the board, which is the policy-making body of the National Science Foundation, presents its report to the President, who transmits it to the Congress. The focus of this year's report is the "new challenge" posed by man's increasing power to shape the future, intentionally and unintentionally, and how science and technology are providing new tools to meet that challenge.

The report reviews some of the contributions recent basic research has made toward solving practical problems. Development of the theory of continental drift, for example, has shed new light on how minerals are de-

posited along the edges of colliding crustal plates, leading to identification of potential new sources of scarce minerals. Also, new deposits of copper in Arizona and lead in Missouri were found using data from the ERTS-1 satellite (now "Landsat").

But challenges have grown apace, and the report pinpoints new areas of vitally needed basic research. Reduction of population growth requires understanding the social and economic incentives that limit family size. Study of simple marine organisms may furnish an environmental "early warning system" to protect society against dangers from pollution that might not show up in humans until after many years' exposure. Though the report skirts the issue of genetic engineering directly, it warns about the growing effect on general public health of dissemination of defective genes—brought about by improved medical care—and urges intensified research into related areas of biology and chemistry.

To evaluate the adequacy of the current state of basic research, the board examines two specific cases, involving contributions from many disciplines and having urgent relevance to the general public—cancer and energy.

Some 50 million Americans living today will be afflicted with cancer and two-thirds of them will die from the disease, if present trends continue. Most of the progress that has been made in curing some of these cancers has resulted from knowledge acquired from basic research, not that directed toward finding a specific "cure."

Since some 80 to 85 percent of all cancers are thought to be caused by agents in the environment—chemicals, viruses or radiation—the need for a multidisciplinary approach is all the more evident. Unfortunately, the report concludes, a deficiency in the number of needed scientists is likely to begin this year, and worsen as the program expands. Already "critical deficiencies" exist in specific areas, including immunology, carcinogenesis, epidemiology and pharmacology.

Again, in the energy area, the future supply of needed scientists and engineers already looks "bleak," and the board concludes (quoting another report) "the supply situation will become considerably worse beyond the mid-1970's if current trends continue toward an overall decrease in the number of graduating physical scientists and engineers."

The board recommends expansion of both pure and applied research, but particularly "untargeted" basic research so that the nation will be better prepared to meet "unforeseen challenges" of the future. Unfortunately, neither the funding nor the manpower appears adequate. □

SCOREing a look at deep reefs

Little detail is known about the life and geologic nature of deep reefs, where steep, undersea cliffs suddenly drop off from the more familiar territory of shallow lagoons. Submersible vehicles can poke around and make photographs, scuba divers with conventional equipment can take very short dives to limited depths, and dredges can bring up random samples of coral and vegetation, but such efforts cannot take the place of prolonged, detailed inspection by trained observers.

Beginning this month, teams of scientist-divers will take turns seeking answers to these oceanographic, biological and geological questions about deep reefs in a pioneering set of dives off Freeport, Bahama Islands, made possible by a series of technological breakthroughs in the diving art. The project, called SCORE (Scientific Cooperative Operational Research Expedition), is a joint effort of the National Oceanic and Atmospheric Administration (NOAA), the Harbor Branch Foundation and the Perry Foundation.

Key to success of the mission is the bringing together of a variety of sophisticated submersible equipment that will allow divers to live and travel underwater while breathing air, rather than more expensive and exotic gas mixtures. To avoid building up nitrogen bubbles in the blood, causing the painful "bends," slow decompression must be performed after any very deep dive; but the amount of decompression is greatly reduced if the diver need not return all the way to the sea surface, but rather can live in an underwater habitat. Recent experiments with these habitats have shown that the deepest a diver can live for long periods of time without the need for special gas mixtures is about 60 feet.

The SCORE mission will thus use the Perry Hydro-Lab, submerged at 60 feet, to house successive teams of four scientists for five days each, while they explore the steep coral reef wall a mile away. Transportation to the wall will be provided by the Johnson-Sea-Link submersible, which can be anchored to the wall, allowing dives of up to 45 minutes to a depth of 250 feet. Divers can then decompress in the submersible on their way back to the habitat. Other equipment will include a submersible Shark Hunter Vehicle, air hoses and safety stations along the diver route for emergency use, and two surface tenders. Program coordinator James Miller told SCIENCE NEWS he hopes that such efforts will eventually be able to allow scientists to work for sustained periods at depths as great as 300 feet using only air.

(Deeper dives are possible if helium is used to replace nitrogen in the gas a diver breathes, but because the molecules are much smaller, special equipment is needed to prevent and detect leaks, and the human voice takes on a squeaky, almost unintelligible quality.

Among the scientific experiments to be performed along the reef wall are collection of plant and animal species, studies of the underlying geological character—including possible oil content, determination of the depth limits of coral growth and various environmental studies. Already, preliminary dives have revealed several animal species that were previously unknown and scientists are eager to learn about their life habits. Study of the abundance and distribution of very small organisms, in particular, will further understanding of possible environmental effects of pollution and other stresses.

French and German scientist-divers will take part in two of the four scheduled missions, with support divers furnished by a Canadian college. If all goes well, within a month, scientists should have a much better idea of what the deep-reef environment is like and what life survives there. □

NOAA

SCORE activity: Hydro-Lab (upper left), Johnson-Sea-Link and diver (lower right) emergency safety stations and lines (along center) and Shark Hunter Vehicle (upper center).