

Marine Bacteria Seen as Precipitation Key

Oceanic bacteria may be the marine atmosphere's main source for triggering precipitation, a scientist from the National Oceanic and Atmospheric Administration (NOAA) reported to the American Meteorological Society meeting 1 April in Seattle, Wash. Russel Schnell of NOAA and two fellow researchers have found that these tiny marine organisms appear to act as an active source of ice nuclei—the particles around which moisture in a cloud freezes to produce precipitation.

The bacteria live in association with marine phytoplankton according to Schnell, and are "shot" into the air by seafoam bubbles bursting on the surface of the waves. Some of them, he believes, find their way high into the air and become the core, or nucleus, around which supercooled water droplets freeze. They fall to the surface of the earth as rain or snow.

Scientists have long known that ice nuclei come from land—particles of dust and possibly decomposed vegetation. Schnell and his colleagues think that a major part may also come from the sea. Schnell, a postdoctoral researcher in the Commerce Department agency's Atmospheric Physics and Chemistry Laboratory; Jayne F. Carney of Biospherics, Inc., and Christine E. Carty of Rutgers University have isolated the particular bacterium but not yet identified it.

Schnell analyzed three years' ice nucleus measurements in the southern hemisphere—chiefly Australia and the Antarctic Ocean—and discovered that the highest concentrations of nuclei were from areas of the ocean favorable to phytoplankton growth. The scientist who had made the measurements had been perplexed to find higher concentrations of nuclei in the air hundreds of miles at sea than over the dusty Australian interior, a finding that did not square with the belief that these nuclei came only from land-based sources.

In another study, Schnell and Gabor Vali of the University of Wyoming collected samples of surface seawater from the Pacific Ocean off North

America, from the Caribbean off Nassau, and from the Atlantic at Bedford, Nova Scotia, and tested them for ice nuclei. Numerous droplets from each sample were placed onto a metal plate and gradually cooled. The numbers of drops that froze at each temperature were recorded. The researchers judged that if the droplets froze at 14°F (-10°C) or warmer, the water contained effective nuclei.

They found that the samples from Bedford had a much higher concentration of nuclei than the other areas. That part of the ocean had recently experienced a "bloom" period of rapid phytoplankton growth. To see if that fact might be related to the high nucleus count, the scientists collected samples of the phytoplankton, added them to distilled water and again tested for nuclei. The concentration was high.

"At first, we thought the phytoplankton itself might be the nucleus," said Schnell. To learn more about the relationship between marine phytoplankton and freezing nuclei, Schnell obtained samples of 23 plankton species from a plankton "library" maintained at Scripps Institute of Oceanography, mixed them with distilled water and measured the nucleus concentrations. He also injected dried, crushed samples of the plankton cultures into a cloud chamber. Samples that contained freezing nuclei would cause particles of supercooled fog in the chamber to freeze, grow into snow crystals, and fall as in a life-size cloud. He found that only three species of plankton contained especially high concentrations of nuclei.

The next step was to pin down what property of phytoplankton actually forms the ice nucleus—the whole or parts of phytoplankton cells, excretion products, or some organism associated with the phytoplankton, such as bacteria. Last August, Schnell, Carney, and Carty collected samples of seawater and fog water off the east coast of Nova Scotia and tested them for both ice nuclei and bacteria. A number of the fog samples contained ice nuclei

capable of causing freezing at temperatures warmer than 23°F (-5°C). Four out of 15 samples of bacteria isolated from the fogs were even more active, triggering freezing at temperatures above 24.8°F (-4°C). Bacteria were also isolated from one of the three species of phytoplankton from Scripps that had exhibited good nucleating ability. When tested, this bacterium was able to cause freezing at 26.6°F (-3°C).

How do these sea-going bacteria get into the atmosphere to do their job as ice nuclei? Nature has a very efficient mechanism to accomplish that, explains Schnell. The bacteria float among plankton at or near the surface of the water. Rising bubbles collect them and upon bursting propel the nuclei into the air at speeds up to and exceeding 100 miles (160 km) per hour. Schnell said that the scum that forms on nearby walls or the light bulb above a home aquarium is evidence of the same process occurring on a smaller scale.

He believes this is the main way marine precipitation may begin: bacteria from the sea acting as freezing nuclei. "Many people don't realize this, but most rain, not just snow, is initiated by an ice nucleus." He added that bacteria have been found inside hailstones, raindrops, and fog droplets. But their central role in possibly causing precipitation is just now being explored.

NOAA Studies Killer Whale Sanctuary Need

The National Oceanic and Atmospheric Administration is investigating the desirability of creating a killer whale marine sanctuary in Puget Sound, reports Robert M. White, NOAA Administrator.

In a letter to Senator Warren Magnuson of Washington, who requested on 5 March that Puget Sound be so designated, White said it appears the State of Washington will work with NOAA in developing information to support the designation process and in connection with the preparation of a draft environmental impact statement.

Should the present information base be adequate to justify the sanctuary, the designation process will proceed. If

major data gaps are revealed, NOAA is prepared to undertake "a reasonable effort to close them," White said.

Marine sanctuaries are designated by the Secretary of Commerce, with the approval of the President, under the authority of the Marine Protection, Research, and Sanctuaries Act of 1972. The program is administered by NOAA's Office of Coastal Zone Management, which processes nominations and makes determinations concerning conditions warranting the designation.

The first two marine sanctuaries named under the program have been the *Monitor* Marine Sanctuary, established 30 January 1975 to protect the site of the Federal ironclad vessel *Monitor* off the coast of North Carolina, and the Key Largo Coral Reef Marine Sanctuary off the coast of Florida, established 18 December 1975.

Automated Nautical Chart System Contract Awarded

Award of a \$1,496,442 contract for construction of the final link in an automated nautical charting system designed by the National Oceanic and Atmospheric Administration (NOAA) has been announced by Secretary of Commerce Elliott L. Richardson. Under the contract, Planning Research Corporation's Information Science Corporation¹, McLean, Va., will prepare an automated information process which will store and retrieve nautical chart information and allow NOAA cartographers to compile charts using computer-generated graphics interacting with a nautical chart data base.

The new charting system, developed by NOAA's National Ocean Survey, is expected to be fully operational by 1980. It will replace the present day manual system, which prints approximately 3 million charts each year for coastal areas, estuaries, harbors, and the Great Lakes.

Allen L. Powell, Director of the National Ocean Survey, said the information system is the final link in NOAA's \$25 million nautical chart automation program that includes the

automated acquisition storage, and retrieval of chart data, compilation of charts, and chart negative production.

"Once the program is fully operational," said Powell, "most data now appearing on nautical charts will be available in digital form for the computer. These data can then be recalled, not only for charts, but for other purposes as well." The computer could provide, for example, a list of wrecks along the coast, including their position, and the depth of the water above them.

Fishers, in the future, also may be able to call upon the National Ocean Survey for a computer-produced list of fish havens; while a request for a list of navigational aids in a specific area could be produced quickly under the automated processes, instead of having it laboriously compiled by hand.

"These are but a few of the examples of what can be accomplished once the automated chart production program is fully operational," Powell said. "We will be able to recall from the digital data files almost everything in the way of nautical data that now appears on our charts."

According to Donald H. Hunt,

Foreign Fishery Developments

British Fishing Industry Faces Change

The following is a condensation of a report by the United Kingdom Whitefish Authority entitled, "The U.K. Fishing Industry: An Account of 1975 and Prospects for 1976." It was prepared by Norman L. Pease, Regional Fisheries Attache, Copenhagen, Denmark.

The year 1975 was a critical year for the U.K. fishing industry since the value of landings fell 5 percent¹ below the 1974 level, while the operating costs increased over 20 percent. However, not all segments of the industry fared alike; late statistics indicate that shellfishers did better in 1975 than in 1974, whereas the herring fishers and deep-sea trawlers' fortunes declined. Real incomes for all fisheres were greatly reduced during 1975. Furthermore, it

Director of the NOS Chart Automation Projects Office, data would include soundings (water depths); prominent landmarks and radio beacons which enable mariners to fix their position at sea; channel limits; bottom characteristics (sandy, gravel, clay, mud, etc.); Coast Guard aids to navigation, such as light buoys, lightships, and electronic navigation systems (Loran); underwater cables and pipelines; submerged navigational hazards, such as wrecks, and shoals; restricted regulated areas; safety shipping lanes; and ship traffic separation lanes for ports.

Automation of chart production will also speed up publication of new and revised charts. "It takes us about 6-9 months now to construct new chart negatives from the time we receive the data," said Richard H. Houlder, Chief of the NOS Marine Chart Division. "Under an automated program, we should be able to produce new chart negatives in 4-6 weeks, once documentation is stored and available for recall. For revised charts, those updated to incorporate new data, production time should be reduced to 3 months or less, instead of the 4 months it now takes."

was a time when the industry had to face up to the prospect of a new fisheries environment. The probability of extension of fishing limits combined with the introduction of reduced quotas demanded structural changes within the U.K. fishing fleet. The fear of the repercussions of such changes caused the industry to operate in a much more unified manner. This was particularly evident in the growth of membership of producer organizations.

The year 1975 began with prices on cod running at a level below that for the corresponding months of 1974. This coincided with the drastic increase in fuel, coupled with an inflation rate of 25 percent per year and resulted in a substantial decline in the real income of U.K. fishers. Fuel costs will rise from the \$16 million in 1972 to \$65 million in 1976.

¹Mention of commercial names or products does not imply endorsement by the National Marine Fisheries Service, NOAA.

¹*Fishing News* (U.K.) reports a 12.4 percent decline in production.