Antifreezes in fish work quite similarly

Though any ordinary cold-blooded creature would freeze solid in the 28.5°F to 32°F polar oceans, some fish species manage to stay fluid and flexible in the supercooled waters by carrying antifreeze in their blood (SN: 11/22/86, p.330). These fish come equipped with a variety of proteins or protein-sugar compounds that stick to forming ice crystals and stunt their growth. Scientists are still puzzling over the mechanism, but a report in the February PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol. 86, No. 3) provides new clues.

Arthur L. DeVries of the University of Illinois in Urbana and his colleagues compared the effects of antifreezes from six different fish. By observing the way the stunted ice crystals grew, the scientists could see which crystal faces the antifreezes attacked. Though they differed in structure, the six compounds worked in strikingly similar ways.

The antifreezes don't lower the temperature at which ice melts — only the temperature at which ice rapidly crystallizes — so there are a few degrees between the melting point and freezing point of such an antifreeze solution. The scientists set the temperature somewhere in this margin and exposed a single ice crystal to each antifreeze.

The exposed ice crystals changed shape as they grew. Normally, the crystals grow in hexagonal prisms — like hexagonal hat boxes. More water molecules tend to stick to the sides of the box than to the top or bottom, making it wider. Antifreeze molecules mainly attacked the sides, allowing only the top and bottom (basal planes) to add layers, so the boxes got tall and skinny.

The antifreezes also changed the crystals in more complicated ways. In all of the six cases, sloping, pyramidal faces emerged and in several the original prism-shaped crystal became a pyramid. In five of the six cases, the antifreeze also slowed growth on the basal planes by causing hexagonal pits to develop. The pits got deeper and wider as new layers built up around them.

The researchers propose that these six quite different molecules could act so similarly if they all have partially charged, or polar, areas the same distances apart. If that were the case, each antifreeze would have the same preferred sites where the polar areas would fit into the crystal lattice. However, another experiment looking at where the individual molecules attached showed that the six types attach to ice differently on a molecular level. Any proposed answer to the antifreeze puzzle will have to take into account both the observed similarities and the differences. *— F. Flam*

Stratospheric winds alter day's length

Scientists have long known that all days are not created equal. Over the millennia, the pull from a gradually receding moon is slowing the Earth's spin and each century adding about two milliseconds to the day. Over shorter periods, different forces cause the day to lengthen or contract by amounts also on the order of milliseconds. While researchers believe that month-to-month changes in day length are driven by shifting wind patterns, the longer year-to-year variations have resisted explanations. Now, a new study suggests that most of these interannual changes appear to result from a combination of two forces, one within Earth's lower atmosphere and another within the upper atmosphere.

In recent years, several researchers have proposed that the climate phenomenon called the El Niño-Southern Oscillation (ENSO) might influence the Earth's angular momentum and thus its rate of rotation. The ENSO is a warming in the Pacific Ocean that accompanies shifts in wind over broad areas of the globe. In a previous study, B. Fong Chao from the NASA Goddard Space Flight Center in Greenbelt, Md., found that ENSOs can change the day's length over periods of several years, but they cannot explain all interannual variation.

Chao now reports in the Feb. 17 SCIENCE that the ENSO in combination with another factor can account for most, if not all, of the year-to-year shifts in day length. This second factor is a pattern of winds in Earth's stratosphere, called the Quasi-Biennial Oscillation (QBO). Like a doughnut around the equator, the winds of the QBO circle tropical regions within the lower stratosphere. Roughly every two years, these winds reverse direction.

It is well known that *tropospheric* winds can subtly speed or slow Earth's rotation through friction on the planet's surface and through torque on mountain ranges. But Chao says it is not yet clear how winds in the stratosphere can alter the planet's spin. A study of the period 1964-1987 shows that the ENSO has twice the strength of the QBO in affecting the length of day.

Richard Rosen, a meteorologist at Atmospheric and Environmental Research, Inc., in Cambridge, Mass., says the new study presents convincing evidence that the QBO and ENSO cause much of the observed interannual changes in day length. Yet he thinks there might be other factors, possibly ocean currents, that also affect the rotation rate on time scales of a year to several years. *— R. Monastersky*

Study refines diet's link to breast cancer

Research has linked some cancers — especially breast cancer — to diet, but studies have offered conflicting data on which foods increase risk most. For breast cancer, fats and/or calories have been implicated most often. A new study of women in northwestern Italy's province of Vercelli not only confirms that general link, but also points a finger at saturated fats and animal proteins as the most potent risk factors.

Explains Paolo Toniolo, an epidemiologist at New York (City) University Medical Center, "We studied Italian women because this population [is very homogeneous] and has a much larger variation in dietary habits" than other groups that have been studied — such as U.S. nurses (SN: 1/3/87, p.4). Together with colleagues at a Turin hospital and the International Agency for Research on Cancer in Lyon, France, he compared the diets of 250 breast-cancer patients against those of 499 healthy women of about the same age — based on questionnaires of foods and portions eaten.

Consumption of carbohydrates (such as starches) and vegetable fats (like olive oil) differed little between the two groups. Somewhat higher protein and fat consumption typical of the breast-cancer group was due entirely to higher consumption of meat and dairy products. In fact, the biggest difference between groups was that women with breast cancer tended to consume considerably more milk, high-fat cheese and butter.

Breast-cancer risk was highest — three times normal for this population — among women who consumed about half their calories as fat, 13 to 23 percent of their calories as saturated fat, and 8 to 20 percent of their calories as animal protein, according to a report in the Feb. 15 JOURNAL OF THE NATIONAL CANCER INSTITUTE. Moreover, limiting total fat to less than 30 percent of calories, saturated fat to less than 10 percent of calories or animal protein to less than 6 percent of calories may substantially reduce risk — below what has been considered normal. Vercelli women consuming such a diet had just half the breast-cancer risk typical for this region.

This suggests that independent of calories, animal fats and proteins increase breast-cancer risk, observes David Kritchevsky, of the Wistar Institute in Philadelphia. That's interesting, he says, because "in our animal experiments, calories seem to be more important than what contributes them." *— J. Raloff*