Montezuma's and other toxins

Only within the last 15 years have microbiologists discovered that *Escherichia coli,* the bacteria ubiquitous in mammalian intestines, can produce diarrhea-causing toxins that often waylay tourists and other susceptible hosts. Two researchers at last week's Bacterial Vaccine Symposium at the National Institutes of Health in Bethesda, Md., reported on the *E. coli* toxins, their role in illness and a new vaccine against some of the toxins.

"Travelers hate to be sick," says Frederick Klipstein of the University of Rochester in New York, and, more importantly, toxin-producing *E. coli* often kill infants, especially in developing countries. For these reasons, Klipstein and others have been working on ways to protect against the toxigenic *E. coli,* and they are close to testing in humans the first synthetic chemical vaccine — inexpensive to make and therefore practical for sale in developing countries.

Because either of two *E. coli* toxins can bring on an attack of traveler's diarrhea, any vaccine must protect against both kinds. Klipstein chemically linked synthetic (and harmless) forms of the two toxins and found that the combination stimulated immunity against both toxins in rabbits and rats. The real test — using the vaccine in humans who have been fed the toxin-producing bacteria — is pending Food and Drug Administration approval.

Still other types of *E. coli* wreak more violent reactions: hemorrhagic or bloody diarrhea, similar to dysentery brought on by the related *Shigella* bacteria. Though the "Shiga-like" toxin of *E. coli* isn't found as often as the kind responsible for traveler's diarrhea, it too is a problem in developing countries. While the toxin has been isolated in infants and adults with diarrhea, Allison O'Brien and her co-workers at the Uniformed Services University of the Health Sciences in Bethesda, Md., are working to definitively show that it is the cause of these symptoms and to relate the level of the toxin to the extent of the disease. So far, they've found lysogenic bacteriophages — viruses within the chromosome of some *E. coli* strains — that seem to increase the production of the Shiga-like toxin.

Until this toxin is proven to cause the bloody diarrhea, development of a vaccine against it will be far off. But O'Brien thinks the Shiga-like toxin may have a bearing on a cholera vaccine that other researchers are developing, since the bacteria that produce cholera toxin produce small amounts of Shiga-like toxin as well. "We're making new discoveries," says O'Brien, "but we still have a lot more to learn."

Talking through the nose

Victims of hypernasality are talking to a computer to cure their speech impediment. The disorder, marked by speech in the mode of actor Peter Lorre, can be caused by stroke or other neurological disorders, cleft palate or palate-disrupting mouth surgery. Or, as for natives of certain parts of Idaho and Utah, it may be the local way of talking.

Researchers at the University of Alabama in Birmingham, led by Larry E. Adams, fashioned a device that measures the air pressure coming from the nose and mouth during speech and hooked the apparatus to a computer. Patients watch a computer-screen display as they try different ways of talking, and see just how well they're doing. Without the computer, feedback isn't very accurate. "The patient would repeat a phrase and we could only say 'that's better' or 'that's good,'" says Adams. "Those comments really don't tell the patients much. The computer actually shows them how close to normal the sounds are."

People with no physiological defects are usually cured within a few weeks, while those with a physical problem take four to six weeks, says Adams. Some of the patients had been in conventional therapy for three years, he says.

Dating ancient air trapped by ice

Buried in layers of Antarctic ice are bubbles of air trapped ages ago. These bubbles are veritable time capsules for scientists charting the history of the atmosphere. They are used, for example, in tracing the natural increase in atmospheric carbon dioxide since the last ice age.

Researchers have developed techniques for extracting and analyzing air samples from ice dating back tens of thousands of years (SN: 5/10/84, p. 296). But until recently the age of the surrounding ice was used to approximate the age of the air, when in fact the two ages are different. It takes 100 to 3,000 years — depending on the snow accumulation rate and temperature at a site — for porous new snow to turn into the dense ice that encloses bubbles. This age difference could be especially critical for studies of bubbles formed in the last two centuries.

That is why J. Schwander and B. Stauffer at the University of Bern in Switzerland decided to quantitatively measure the age difference between the ice and trapped air at the Siple Station in Antarctica, where they were studying the carbon dioxide content of air captured since 1800. By measuring the age of the ice at a depth where closed bubbles have just begun to form around present-day air, the researchers, whose work appears in the Sept. 6 NATURE, found that the ice-air age difference averaged 95 years. Using a semi-empirical formula, the scientists also made estimates of age differences at other locations in the Antarctic. For example, at the Vostok site where snow accumulates slowly, they calculated an ice-age difference of 2,800 years.

Solar UV and ozone: A stronger link

Scientists have long suspected that ultraviolet (UV) radiation emitted by the sun plays an important role in the photochemical production of stratospheric ozone. But data collected over the last decade that tend to support this conclusion (SN: 6/23/79, p. 405) have been somewhat controversial because most of the measurements were made with ground-based instruments that are susceptible to interference from varying weather conditions and other geophysical events. Now, a cleaner and more precise experiment has been done from the Nimbus 7 satellite, proving once and for all that solar UV enhances the production of ozone at altitudes of 30 to 50 kilometers. The results also point to significant changes in stratospheric ozone over the 11-year cycle of sunspot activity.

Atmospheric scientists John C. Gille and Charles M. Smythe at the National Center for Atmospheric Research in Boulder, Colo., and Donald F. Heath at the NASA-Goddard Space Flight Center in Greenbelt, Md., monitored solar UV and ozone concentrations in the tropical stratosphere for five months during the winter of 1979. At that time, they noted that the solar UV output at the 205-nanometer wavelength varied by 1 percent every 13.5 days. The scientists report in the July 20 SCIENCE that the ozone concentration correspondingly changed from about 0.2 percent at the bottom of the stratosphere to 0.45 percent at the top.

The effect is small for the 13.5-day period, but the results imply a much greater change of 12 percent at the top of the stratosphere when the data are combined with a theoretical model of the sun's activity over its 11-year cycle. This variation, say the researchers, should be included in studies on the effects of human activity, such as the release of chlorofluoromethanes from aerosol sprays, on ozone in the upper stratosphere. This means that more accurate experiments are needed to monitor the solar spectrum and ozone levels over many years.

The most intriguing aspect of the recent results, says Gille, is that the photochemistry producing ozone from oxygen is progressing much faster than expected. The current model predicts that at 30 kilometers the ozone content increases about two days after an increase in solar UV. Instead, Gille's group observed a lag time of about one day at that altitude.