Chemistry

Antibiotics better in pairs

Many types of infectious bacteria, once easily killed by a course of penicillin, have become resistant to even the best antibiotics. They are already beginning to break through the last line of defense, the relatively new drug vancomycin. In intensive-care units, about 15 percent of some bacterial infections are vancomycin-resistant, according to the Centers for Disease Control and Prevention in Atlanta.

Researchers are now exploring a way to fortify this defense. A new study shows that two vancomycin molecules connected together have an enhanced ability to kill antibiotic-resistant bacteria. The report by Uma N. Sundram and John H. Griffin of Stanford University and Thalia I. Nicas of Lilly Research Laboratories in Indianapolis appears in the Dec. 25 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

Eight years ago, Dudley H. Williams and his colleagues at the University of Cambridge in England discovered that molecules similar to vancomycin could easily pair up with each other, forming what are known as dimers. They subsequently demonstrated that dimers are more effective antibiotics than single molecules. Vancomycin, however, "is pretty lousy" when it comes to pairing with itself, Griffin says.

To overcome this weakness, Griffin and his colleagues linked two vancomycin molecules using different chemical bridges. The dimers destroyed vancomycin-resistant bacteria much better than single vancomycin units.

Vancomycin works by binding to a specific piece of protein, preventing it from incorporating into the bacterial cell wall. "A dimer allows simultaneous delivery of two antibiotic molecules to the surface of a bacterium," says Williams, thus making it easier for the vancomycin to bind to the correct piece of protein.

What's puzzling, Griffin says, is that the dimers don't seem to have enhanced antibiotic activity against bacteria that normally succumb to vancomycin. Looking more closely at how the dimer binds to the bacterial protein could help explain why, he adds. — *C.W.*

System mimics photosynthesis

For years, scientists have looked to plants to learn how best to harness the energy of the sun. Now, researchers have used those lessons to create a simple system that mimics photosynthesis.

Embedded in a lipid membrane, the system absorbs light and uses the energy to pump protons across the membrane, creating an unequal distribution between the sides. The flow of protons back across the membrane generates a force that can be harnessed to power biological processes, says Devens Gust of Arizona State University in Tempe. Gust, Thomas A. Moore, and their colleagues report their achievement in the Jan. 16 NATURE.

The system consists of a three-molecule reaction center that spans the thickness of the membrane and another molecule, a quinone, that acts as a proton shuttle. When the reaction center absorbs a photon of light, the energy is stored as a separation of charge. At the outer surface of the membrane, the reaction center is then negatively charged and gives an electron to the quinone. The quinone picks up a proton and moves across the membrane. When it reaches the positively charged end of the reaction center, it gives back the electron and releases the proton.

In living organisms, the subsequent flow of protons back across the membrane triggers the synthesis of ATP, a molecule Gust calls "the gasoline of life." Controlling ATP synthesis with a pulse of light would provide a new way to study biological processes fueled by the molecule, Gust says. The group is now working on expanding the system to produce ATP, thus creating an artificial biological power station. — *C.W.*

Science & Society

Asthma epidemic: A link to moving . . .

Worldwide, both the incidence and severity of asthma—an inflammatory disease of the airways—have been increasing. In the United States, for instance, this source of wheezing and chronic breathing difficulties afflicts some 12 million people, an increase of roughly 60 percent in just a single decade.

Though many studies have linked asthma to allergies, no one has explained the recent epidemic, especially in children. One provocative possibility, now tendered in the January ARCHIVES OF DISEASE IN CHILDHOOD, is household moves.

In 1992, pediatrician Jane B. Austin of the Royal Northern Infirmary in Inverness and her colleagues tallied cases of asthma among 12-year-olds in Scotland's Highlands. "Though we're very rural," she says, "we found the prevalence of asthma was 14 percent—as high as in some urban areas," such as industrial Aberdeen, known for its petrochemical facilities. This seemed to eliminate outdoor pollution as a risk, Austin says.

Indeed, a tally of teen asthma on Scotland's Isle of Skye "was just as high as [on] the mainland—slightly higher, actually. And you can't get a more pollutionfree area than this island."

So in the Highland study, she and George Russell of the University of Aberdeen turned their attention to indoor environmental factors, such as pet dander, open fires for home heating, parental smoking, double-glazed windows, which can trap pollutants inside, and wall-to-wall carpeting, which can harbor dust mites. Among the roughly 1,500 12- and 14-year-olds surveyed, "we didn't find even one factor that seemed to be accounting for the prevalence of asthma," she says.

A smaller study by other researchers had hinted that household moves might pose an asthma risk by increasing the number of allergens—substances that can provoke allergic reactions—to which a child might be exposed. Austin investigated the idea in her population and found that "the more times a child had moved, the higher the likelihood of asthma."

While acknowledging that this controversial link "may be due to chance," she says, "I do think it's worth exploring in more detail." — *J.R.*

. . . or childhood vaccinations?

Several studies have shown that the incidence of allergies and asthma tends to rise in countries where childhood immunization rates are high. This has prompted some researchers to suggest that certain infections may trigger immune changes that somehow protect children from developing allergies and asthma later. Preliminary studies have shown a protective effect of, for example, measles and infections with some intestinal parasites.

Indeed, this observation may explain the findings of a new study involving 867 school-age children in Japan.

Taro Shirakawa of Churchill Hospital in Oxford, England, and his coworkers compared a history of asthma and other allergic conditions in these children with whether the youngsters had been vaccinated against tuberculosis. They also surveyed if and when a child tested positive on a skin test for the disease.

In the Jan. 3 SCIENCE, they report that children who tested positive for tuberculosis—probably as a response to the vaccine—were only one-third as likely to have allergies as those who tested negative. Similarly, children testing positive were only one-half to one-third as likely to exhibit asthma symptoms.

In an accompanying editorial, William O.C.M. Cookson and Miriam F. Moffatt of the University of Oxford speculate "that the decline in childhood tuberculosis infection in Japan is causal in the recent asthma epidemic." Since tuberculosis triggers a reaction called delayed hypersensitivity in the immune system, the pair suggests that a vaccine designed to elicit this response might prove effective in fighting allergy and asthma in children. — *J.R.*