Chemical picture of a bacteria

FOR the first time, scientists have been able to paint a detailed chemical picture of how a particular strain of bacteria has evolved to become resistant to antibiotics. The research is a key step toward designing compounds to prevent infections by recently evolved, drug-resistant "superbugs" that often are found in hospitals, as well as in the general population.

The research was conducted by a team led by Squire Booker, an associate professor in the department of chemistry and the department of biochemistry and molecular biology at Penn State University. This paper is a continuation of research led by Booker published in another paper in Science earlier this month.

The team began by studying a protein made by a recently evolved "superbug." Booker explained that, several years ago, genetic studies had revealed that Staphylococcus sciuri -- a non-human bacterial pathogen -- had evolved a new gene called cfr. The protein created by this gene had been found to play a key role in one of the bacterium's mechanisms of antibiotic resistance. Later, the same gene was found to have crossed over into a strain ofStaphylococcus aureus -- a very common kind of bacteria that constitutes part of the flora living in the human nose and on the skin, and which is now the cause of various antibiotic-resistant infections. Because this gene often is found within a mobile DNA element, it can move easily from a non-human pathogen to other species of bacteria that infect humans.

"The gene, which has been found in Staphylococcus aureusisolates in the United States, Mexico, Brazil, Spain, Italy, and Ireland, effectively renders the bacteria resistant to seven classes of antibiotics," Booker explained. "Clearly, bacteria with this gene have a distinct evolutionary advantage. However, until now, the detailed process by which the protein encoded by that gene affected the genetic makeup of the bacteria was unclear; that is, we didn't have a clear 3D picture of what was going on at the molecular level."

To solve the chemical mystery of how such bacteria outsmart so many antibiotics, Booker and his team investigated how the Cfr protein accomplishes a task called methylation -- a process by which enzymes add a small molecular tag to a particular location on a nucleotide -- a molecule that is the structural unit of RNA and DNA. When this molecular tag is added by a protein called RlmN, it facilitates the proper functioning of the bacterial ribosome -- a gigantic macromolecular machine that is responsible for making proteins that bacteria need to survive. Many classes of antibiotics bind to the ribosome, disrupting its function

Scientists have discovered a novel strategy by which antibiotic-resistant bacteria change their genetic make-up to evade multiple antibiotics

and thereby killing the bacteria. The Cfr protein performs an identical function as the RlmN protein, but it adds the molecular tag at a different location on the same nucleotide. The addition of the tag blocks binding of antibiotics to the ribosome without disrupting its function.

"What had perplexed scientists is that the locations to which RlmN and Cfr add molecular tags are chemically different from all others to which tags routinely are appended, and should be resistant to modification by standard chemical methods," Booker said. "What we've discovered here is so exciting because it represents a truly new chemical mechanism for methylation. We now have a very clear chemical picture of a very clever mechanism for antibiotic resistance that some bacteria have evolved."

Booker also said he believes the next step will be to use this new information to design compounds that could work in conjunction with typical antibiotics. "Because we know the specific mechanism by which bacterial cells evade several classes of antibiotics, we can begin to think about how to disrupt the process so that standard antibiotics can do their jobs," he said.

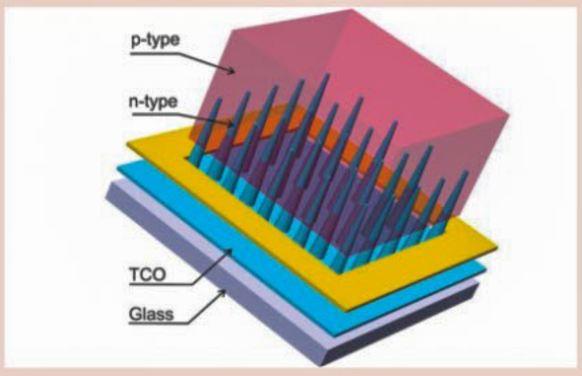
In addition to Booker, other researchers who contributed to the upcoming Science paper include Tyler L. Grove and Neela Yennawar of Penn State; Amie K. Boal and Amy C. Rosenzweig of Northwestern University; and Monica McLaughlin, a student at the State College Area High School. Additional scientists who contributed to the first Science paper include Tyler L. Grove, Matthew Radle, Jessica Ahlum, Bradley Landgraf, and Carsten Krebs of Penn State; and Jack Benner of New England Biolabs.

The research was funded, in part, by Penn State University, the U. S. Department of Energy, the National Cancer Institute and National Institute of General Medical Sciences of the U. S. National Institutes of Health, and New England Biolabs

Source: Science News

NEW SOLAR CELL

Nanotech boosts solar cell



Nanocone-based solar cell consisting of n-type nanocones, p-type matrix, transparent conductive oxide (TCO) and glass substrate

WITH the creation of a 3-D nanocone-based solar cell platform, a team led by Oak Ridge National Laboratory's Jun Xu has boosted the light-to-power conversion efficiency of photovoltaics by nearly 80 percent.

The technology substantially overcomes the problem of poor transport of charges generated by solar photons. These charges -- negative electrons and positive holes -- typically become trapped by defects in bulk materials and their interfaces and degrade performance.

"To solve the entrapment problems that reduce solar cell efficiency, we created a nanocone-based solar cell, invented methods to synthesize these cells and demonstrated improved charge collection efficiency," said Xu, a member of ORNL's Chemical Sciences Division.

The new solar structure consists of n-type nanocones surrounded by a p-type semiconductor. The n-type nanoncones are made of zinc oxide and serve as the junction framework and the electron conductor. The p-type matrix is made of polycrystalline cadmium telluride and serves as the primary photon absorber medium and hole conductor.

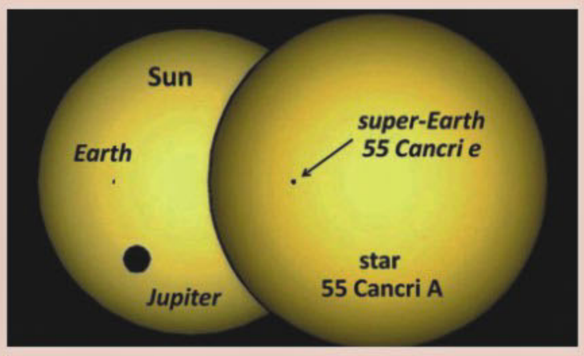
With this approach at the laboratory scale, Xu and colleagues were able to obtain a light-to-power conversion efficiency of 3.2 percent compared to 1.8 percent efficiency of conventional planar structure of the same materials.

"We designed the three-dimensional structure to provide an intrinsic electric field distribution that promotes efficient charge transport and high efficiency in converting energy from sunlight into electricity," Xu said.

Source: Science Daily

PANDORA ECLIPSED

'Exotic Super-Earth:'



Family portraits of two planetary systems: A simulation of the silhouette of planet 55 Cancri e passing in front of ("transiting") its parent star

An international team of astronomers have revealed details of a "super-exotic" exoplanet that would make the planet Pandora in the movie Avatar pale in comparison.

The planet, named 55 Cancri e, is 60 percent larger in diameter than Earth but eight times as massive. Twice as dense as Earth -- almost as dense as lead -- it is the densest solid planet known, according to a team led by astronomers from the Massachusetts Institute of Technology (MIT), the University of British Columbia (UBC), the Harvard-Smithsonian Center for Astrophysics and the University of California at Santa Cruz (UCSC).

The research, based on observations from Canada's MOST (Microvariability & Oscillations of STars) space telescope, has been submitted for publication in The Astrophysical Journal Letters. MOST is a Canadian Space Agency mission.

Approximately 40 light years from Earth, 55 Cancri e orbits a star -- called 55 Cancri A -- so closely that its year is less than 18 hours long. "You could set dates on this world by your wrist watch, not a calendar," says UBC astronomer Jaymie Matthews.

Source: Science daily

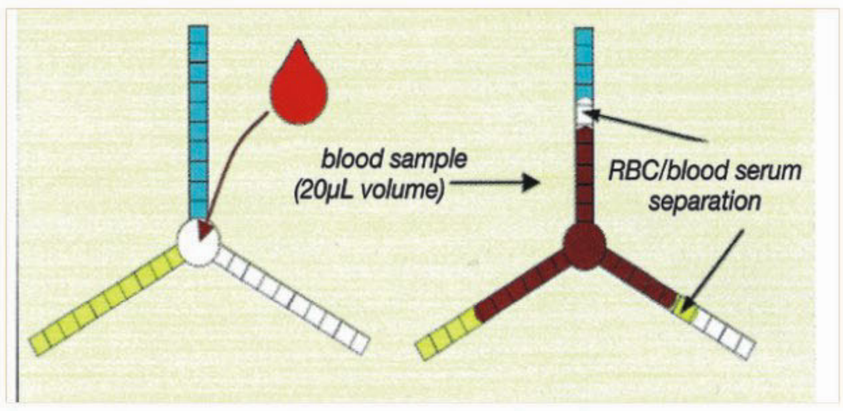
IT'S IN A PAPER

Testing blood type made easier

FAUZIA SULTANA

IT would be, rather, a rare instance to find people not knowing their height or weight; but not knowing the blood type is a common phenomenon. Be it for the health insurance card or the driver's license, many a times we fail to provide our blood type either because we forgot the type or we never knew it. Blood typing is one of the most vital medical tests, yet many of us are unaware of our blood type and ignorant of the dire consequences this could lead to. Conventional blood typing methods are time-consuming, not on-the-spot and require the use of sophisticated instruments that are unavailable in many less developed countries. In scenarios, like a blood transfusion or an organ transplant, where knowing the blood becomes extremely crucial, an instantaneous test is certainly a remedy. At Monash University, Australia, Dr. Mohidus Khan*, a young Bangladeshi researcher, and his team developed the first ever paper diagnostics to determine blood type, that costs only a few cents and is as simple as placing a droplet of blood onto the paper strip, revealing the blood type in a minute or two.

Blood Properties: Based on antigens, namely A, B and D present on the surface of red blood cells (RBCs), people have the following blood types: A (+/-), B (+/-), AB (+/-), and O (+/-). When these antigens interact selectively with their counter antibodies, A, B and D, e.g., antigen A interacting with antibody A, agglutination or clumping occurs. This increases the viscosity and consequently the blood flow (Ref :M S Khan et al, Anal. Chem., 2010, 82, 4158-4164). Based on these properties, a paper based blood typing test has been developed, where an antigen recognition agent in the paper structure specifically binds to antigens, resulting in a



(Ref:M S Khan et al, Anal. Chem., 2010, 82, 4158-4164) Schematic of colorimetric indication of phase separation on the paper channels

Mechanism of Blood Typing: The paper diagnostic is a three arms prototype (Figure1). Each arm is treated by printing different biological substances using a modified ink-jet printer, in which the ink is replaced by a solution of antibodies. When a drop of blood is placed in the center of the paper, it moves along each arm. When the specific antibody is met with and adsorbed on the surface of the antigen, the blood agglutinates and forms clumps of antigen-antibody complex, resulting in chromatographic separation of the RBCs from the plasma and revealing the blood type (Ref :M S Khan et al, Anal. Chem., 2010, 82, 4158-4164).

"From Monash University, we have patented the concept of blood typing using paper diagnostics and are currently working with industrial partners for further development of the technique. We believe this work will open a new horizon to the researchers and will lead to the development of different pathological tests, yet restricted in well equipped pathological labs, using the much convenient paper diagnostics", says Dr. Khan.

Paper based diagnoses, in the form of diabetes or pregnancy tests are prevalent for years.

Compared to the conventional blood typing device available, the new technology of paper based analysis for instantaneous blood typing is cheap, biodegradable and most importantly a means by which patients, in both developed and developing countries can get the right treatment, faster.

Dr. Mohidus Khan is now working as a post-doctoral fellow at the Department of Chemistry, McGill University, Canada.

The writer is a Chemical Engineer from BUET

ALIENS INVADE SOUTH

Antarctica threatened?

IT'S unforgivingly cold and isolated, but stowaways are arriving in Antarctica in a steady stream. Seeds, fungi and insects go where people -- in this case researchers and tourists -- take them. These arrivals all create the potential for invasive species to establish themselves in the world's most pristine continent and its islands.

"We are still at the stage when Antarctica has fewer than 10 non-native species, none of which have become invasive," said Kevin Hughes, an environmental scientist with the British Antarctic Survey. "Unless we take steps now to minimize the risk of introduction, who knows what will happen."

Invasive species are non-native species that flourish in a new habitat, where they often kick out native organisms and harm human interests by disrupting crops, clogging waterways and causing a myriad of other problems.

Hughes and other researchers have set out to determine just what is being carried unintentionally into some of the international research stations in the Antarctic. In one study, he and others examined more than 11,250 pieces of fresh produce arriving at nine research stations in the Antarctic and the sub-Antarctic islands located farther north in the Southern Ocean to see what came along with it.

The produce, which included everything from apples to pawpaw trees to turnips, was shipped from around the world. Its stowaways were similarly diverse, and included at least 56 invertebrates -- slugs, butterflies, aphids and so on. Twelve percent of the produce carried soil, and 28 percent had rot caused by microbial infection. [Taking a Bite Out of Invasive Species]

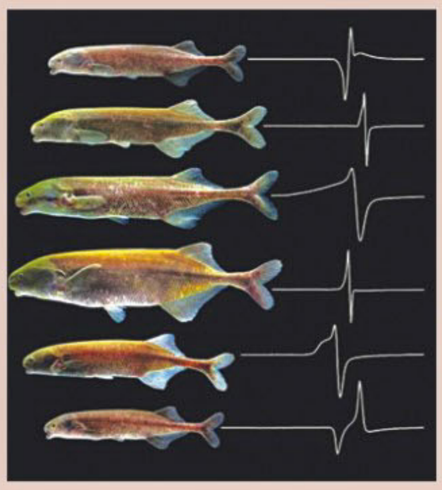
"Are these numbers surprising, or does it mean this is likely to be a problem? It's pretty hard to say," said Daniel Simberloff, a professor at the University of Tennessee, Knoxville, who was not involved with the research. "The upshot is that there's just enough people going to some parts of Antarctica nowadays that lots of organisms are carried there. I have to think this isn't good, and some subset of them are going to pose environmental problems."

Source: Live Science.

A plane flying above Rothera Research Station, one of nine stations in Antarctica where nonnative species were found among fresh produce.

BRAIN MATTERS

Zap! More fish



Source: Science News

BETTER brains make one fish, two fish, into lots and lots of fish.

After upgrading their ability to communicate using electrical signals, a group of African fish exploded into dozens of species. This may be the first study to show a link between central brain evolution and increasing species diversity, researchers report in the April 29 Science.

"The brain structure triggered an explosion of signals and an explosion of species as a result," says Carl Hopkins, who studies neurobiology and animal behavior at Cornell University and was not involved in the new study.

Among mormyrid fish, conversation is literally buzzing. Using specialized electricity-emitting organs in their tails, these African natives string together short shocks into a primitive analog to Morse code, says study coauthor Bruce Carlson, a neuroecologist at Washington University in St. Louis. Mormyrids can't discuss philosophy, but they can employ this rat-a-tat to send out some basic signals for instance, "I'm interested in mating with you."

DID YOU KNOW?

Graham Bell hated telephone!

Even Alexander Graham Bell, who was awarded the patent for the invention of the telephone, disliked telephones so much that he refused to have one in his office. But that should not come as a surprise because both his mother and wife was deaf and perhaps Bell who also was a speech teacher to the deaf was only considering them.

When Bell passed away in 1922, every telephone served by the Bell system in the USA and Canada was silent for one minute.