Chemistry

Cloaked blood hides from immune system

For people with blood disorders such as thalassemia or sickle-cell anemia, repeated blood transfusions become a part of life. The introduction of so many foreign cells often makes transfusion recipients sensitive to the hundreds of antigen proteins on the surface of red blood cells. Over time, it becomes increasingly difficult to find suitable blood for them.

Now, researchers have found a way to hide those cell surface proteins, thus rendering the cells invisible to the immune system. Mark D. Scott of Albany (N.Y.) Medical College and his colleagues link long molecules of polyethylene glycol (PEG), a nonimmunogenic substance, to the proteins, creating what they call "fuzzy little red cells." The PEG fuzz keeps out large proteins like antibodies but allows small molecules such as oxygen and glucose to diffuse in. That way, the cells are protected from attack by immune cells yet can still function normally. The scientists describe their work in the July 8 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

In mice, treated blood cells survive just as long as untreated ones. Furthermore, Scott says, "as an extreme test, we transfused blood between two different species." Untreated sheep blood cells injected into mice lasted only about 5 minutes, but PEG-treated cells lasted for hours.

It will be a few years before the technique can be tested in people. In test-tube studies, PEG-treated human blood cells were protected from antibodies and functioned normally. Scott suggests that this treatment could be combined with a method that converts blood types A and B into type O by trimming characteristic cell surface proteins (SN: 1/11/97, p. 24). PEG could disguise any cell surface proteins not affected by the conversion.

The technique may prove useful not only for human blood transfusion but also for veterinary medicine. "You don't have centralized blood banks, yet you still have to match blood. This is very low-tech, so it can be easily translated into a veterinary practice," Scott says. —*C.W.*

Another way to search for new drugs

The enzyme that synthesizes the antibiotic erythromycin acts like a tiny assembly line, adding molecular components along a sequence of 27 active sites to create the finished product. Now, scientists have developed a way to harness the enzyme's machinery to produce hundreds of compounds with potential antibiotic activity.

First, the researchers block the early synthesis steps of the enzyme, halting its natural production of erythromycin. Then, by feeding it synthetic molecules, the researchers trick the enzyme into channeling those new precursors into the assembly line. In the end, "all of the molecules will be similar to erythromycin," says John R. Jacobsen of Stanford University, so they are likely to possess antibacterial activity. They may be sufficiently different, however, to get around the problems of erythromycin resistance.

The researchers call the technique "combinatorial biosynthesis," a method of making lots of compounds that can then be tested for utility. "A chemist can make almost anything in the lab, but it's a lot of work," Jacobsen says. With this procedure, chemists can exercise some control through the precursor molecules fed to the enzyme, but the enzyme itself carries out most of the tedious manufacturing steps. Their findings appear in the July 18 SCIENCE.

In the first experiments, the researchers tested three compounds: one closely related to the enzyme's natural precursor; a second, slightly bulkier molecule; and a third that is more closely related to a molecule formed farther down the assembly line. Jacobsen says they were "quite surprised" to see the enzyme work on all three molecules. In future experiments, the group plans to test the enzyme's flexibility. —*C.W.*

Mathematics

An enormous chunk of pi

Computation of the digits of pi (π), the number representing the ratio of a circle's circumference to its diameter, has taken a giant leap forward. Computer scientist Yasumasa Kanada and his coworkers at the University of Tokyo Computer Centre last month reported calculating 51.5396 billion decimal digits, besting their previous world record of 6.4 billion digits (SN: 10/28/95, p. 279). The calculation was done twice, with two different methods, as a check. One computation required 29 hours and the other 37 hours on a multiprocessor Hitachi SR2201 computer.

This is a landmark achievement, says mathematician Jonathan M. Borwein of Simon Fraser University in Burnaby, British Columbia. The main reason for the greatly improved performance was the division of the task among 1,024 processors, which cut computation time considerably.

Kanada's analysis of the first 50 billion digits of pi shows that the number 8 appears most often (5,000,117,637 times) and 3 least often (4,999,914,405 times).

By using additional computer time, the record can be pushed a little higher, Kanada says. Reaching 100 billion digits, however, would require a much more powerful computer with additional memory. —*I.P.*

Lava lamp randomness

Sealed within a transparent, tapered, liquid-filled cylinder, illuminated colored globs slowly rise and fall. Meandering and deforming, their shapes and paths change unpredictably. Invented in 1963, a decorative fixture in many homes during the 1970s, and still in production, Lava Lite lamps are now the object of renewed curiosity. Indeed, researchers have come up with a novel application of the mesmerizing movements of the lamp's globules. They use them as the starting point for generating a sequence of random numbers. Called lavarand, the new random-number generator is the work of Robert G. Mende Jr., Landon Curt Noll, and Sanjeev Sisodiya of Silicon Graphics in Mountain View, Calif.

Random numbers are an immensely valuable commodity, not only for the operation of computer-based slot machines but also for computer simulations and for generating the secret strings of digits required to encode and decode sensitive information in cryptographic systems (SN: 11/9/91, p. 300). The trouble is that no numerical recipe used by a computer produces truly random numbers. The computer simply follows a set procedure, and restarting the process with the same initial number, or seed value, produces exactly the same sequence of digits.

One way to do better is to vary the seed value randomly. Noll and his colleagues decided that the unpredictably wandering globs in a Lava Lite lamp, operated according to the manufacturer's instructions, are a more convenient source of randomness than, say, the sporadic decays of a radioactive element. "While any good chaotic source could be used, we favor Lava Lite lamps in part because they were the source of inspiration for lavarand and in part because they are cool," the researchers admit.

A digital camera periodically photographs a set of six Lava Lite lamps, each one generally in a different stage of activity. The camera adds its own electronic noise to the data, and the resulting image is converted into a string of 1s and 0s. That string is then mathematically manipulated according to a scheme known as the National Institute of Standards and Technology's Secure Hash Algorithm, which compresses and scrambles the 921,600 bytes of the original image into a 140-byte packet of digits. This packet then serves as the seed value for a computer-based random-number generator. Each such value starts a chain of mathematical operations that produces a different string of apparently random digits.

Silicon Graphics has applied for a patent on the lavarand method of generating random numbers. —*I.P.*