Biomedicine

Julie Ann Miller reports from Washington, D.C., at the meeting of the American Association for Dental Research

Colonizing the mouth with benign bacteria

Mutant bacteria especially adept at establishing themselves in the human mouth have been developed by scientists at the Forsyth Dental Center in Boston. They expect these bacteria to serve as the missing link in attempts to replace cavity-causing bacteria with mutant strains that do not generate the large amounts of acid that decay teeth.

About nine years ago Jeffrey D. Hillman and his colleagues at Forsyth, working with colonies of the bacterium *Streptococcus mutans,* isolated a mutant that produces only low levels of acid. Later, when they introduced the mutant strain into mouths of germ-free rats, the rats remained cavity-free throughout their lives despite a diet high in sugar (SN: 12/8/79, p. 394). But this promising bacterium never succeeded as a dental therapy, because it was unable to take over a human mouth already occupied by the natural, cavity-causing strain. "The human mouth is a more complex ecosystem than that of the rat," Hillman says.

So Hillman and his colleagues went back to natural bacterial populations from human mouths to find a strain that is a better colonizer. They now report they isolated such a bacterium (called JH1001) and created a mutant of it that is an even more successful colonizer (JH1005). These bacteria produce a chemical, called a bacteriocin, that stops the growth of closely related strains.

Three Forsyth staff members had their teeth cleaned, then brushed and flossed with JH1005 cells for five minutes. Now, almost a year later, that strain is the dominant *S. mutans* in their mouths. An unexpected finding is that in these volunteers the total number of all *S. mutans* bacteria in their mouths is significantly depressed. However, levels of a similar bacterium, *S. sanguis,* that occupies a similar niche was not depressed by the *S. mutans* mutant.

Now the scientists plan to combine in a single strain the characteristics of low acid production and successful colonization. "Hopefully we'll have such a strain in a couple years," Hillman says. "Colonization has been the major stumbling block." According to the American Association for Dental Research, "The findings to date lend strong support to the practical application of replacement therapy for the prevention of tooth decay."

A family resemblance to King Tut

A controversial Egyptian mummy has now been identified as the half-brother of King Tutankhamen, who lived at about 1358 BC. The finding was achieved through the use of a technique usually employed to measure craniofacial bones in patients undergoing orthodontic treatment. James E. Harris and his colleagues at the University of Michigan in Ann Arbor and at the Egyptian Museum in Cairo used a laser beam to determine the orientation of the poorly preserved mummy's skull, and then they applied cephalometry, a precise X-ray technique that does not damage mummies.

From the resultant skull measurements, the investigators produced computer drawings of the skull that permit statistical comparison of craniofacial characteristics of mummies. They determined that a previous skull description was incorrect. Harris and his colleagues concluded that the mummy was of a middle-aged, slight male who showed similarities to Tutankhamen. The computer reconstruction shows that the skull resembles funerary artifacts and sculpture depicting Tutankhamen's half-brother Smenkhare.

The mummy came from a tomb thought to belong to members of the royal family of the dynasty ending with Tut. Some previous analyses had concluded the mummy was Smenkhare, another member of the royal family or an unidentified young female.

Technology

Robot staff for nuclear power plants

Someday a nuclear power plant may have a staff of robots, each designed for a specific function but flexible enough to take over other tasks when needed. The Electric Power Research Institute (EPRI), a utilities-sponsored research organization based in Palo Alto, Calif., has introduced the first potential member of that staff.

"Surveyor," a brightly colored, remotely controlled robot about the size of a giant tortoise, is designed to inspect equipment, read meters and survey for radiation. With an extendable arm attachment, the 350-pound, tanklike robot can also reach into areas too confined for human work.

Developed for EPRI by Advanced Research Development Corp. in Columbia, Md., the robot has been tested in several nuclear power plants. So far, however, the machine has not ventured into radiation areas because the Nuclear Regulatory Commission has yet to determine the conditions under which robots can be used in such areas.

Researchers are also working on a second robot staff member. For EPRI, Odetics, Inc., of Anaheim, Calif., is developing a walking robot that would be able to thread mazes, step over obstacles and squeeze through narrow gaps (SN: 7/6/85, p. 9). With its great strength-to-weight ratio, this robot would serve as a heavy-duty maintenance worker.

Bubbling up to a bigger picture

The displays that generally show up in digital watches or tiny TV sets usually consist of thin liquid-crystal films sandwiched between transparent plates. This system, however, requires a polarizing filter for viewing and is difficult to use for large screens. A new display technology overcomes these difficulties by replacing the liquid-crystal sandwich with a thin, clear plastic film loaded with liquid-crystal bubbles. Such a scheme makes possible large, flexible displays.

J.W. Doane and his colleagues at Kent (Ohio) State University have shown that certain liquid-crystal substances can be embedded as microscopic spheres within sheets of plastic. The bubbles form spontaneously during polymerization. These spheres normally scatter light in all directions so that the plastic film appears white. When an electric field is applied, the liquid-crystal molecules in the region align themselves, and scattering is reduced. These regions appear dark against a white background. Doane's report appears in the Jan. 27 APPLIED PHYSICS LETTERS.

Burning to a toxic waste

During the past decade, researchers have shown that the incineration of municipal and industrial wastes often produces traces of toxic compounds such as dioxins. Until now, however, no one had a clear idea of how these compounds are formed. A Swedish research team, reporting in the March 13 NATURE, argues that the presence of phenol, often found in household wastes, and hydrochloric acid, sometimes supplied by the fuel, is likely to lead to the formation of toxic substances when wastes are burned.

In a simple, high-temperature experiment, Göran Eklund and his colleagues at Studsvik Energiteknik AB in Nyköping, Sweden, showed that phenol, when heated together with hydrochloric acid in sealed quartz tubes, readily reacts to form a mixture of chlorinated products. This mixture closely resembles the pollutants typically found in flue gases from municipal incinerators.

The researchers also found that the reaction depends very strongly on the hydrochloric acid concentration. They suggest that one way of reducing toxic pollutant emissions would be to inject along with the incinerator fuel a substance that neutralizes acids.