SCIENCE NEWS of the week

Skin Reborn From Muscle

The dermis, the skin's lower layer, does not naturally regenerate. Instead, when swatches of it are lost to burns or other injuries, the nearby skin covers the wound and forms a scar. Unfortunately, the extended skin and scar are not as elastic as normal skin. This can leave burn victims with permanently contorted limbs if the skin covering joints is lost.

Over the last decade, a team of MIT researchers has developed a polymer matrix that discourages wound contraction and instead promotes the growth of new skin. Now the group, led by Ioannis Yannas, has preliminary evidence that the regenerated skin appears to be synthesized from a completely different tissue, namely the underlying muscle. If confirmed by future work, Yannas says, this may mean that "a person who lost almost all of [his or her] skin in a fire can be induced to regenerate skin using the muscle as a substrate." He reported on the new findings at last week's meeting of the American Chemical Society in New Orleans.

Yannas's group developed its first "artificial skin" in 1975. This highly porous, cross-linked matrix of collagen fibers (from cowhide) and a carbohydrate polymer (from shark cartilage) called glycosaminoglycan has since been used successfully to treat more than 100 severely burned patients who had lost most of their skin down to the muscle. According to Yannas, one company has licensed the MIT patents with the intention of marketing the polymer if it is approved by the Food and Drug Administration.

The researchers later inoculated the membrane with young cells from the upper, epidermal layer (SN: 1/30/82, p.73) and showed in animal studies that the polymer generated not only a dermis, but an almost "flawless" epidermis and interlying "basement" membrane as well. Clinical studies of this "Stage 2" polymer matrix are now being conducted by John F. Burke at Massachusetts General Hospital in Boston. If all goes well, the membrane may be an attractive alternative to autografting — in which pieces of the patient's own skin are applied to wounds — especially for badly burned patients. Unlike other burn treatments, such as the use of cadaver skin or synthetic polymeric dressings, the polymer and autografting techniques provide permanent coverage.

It is on the basis of "island graft" experiments recently performed on guinea pigs that the MIT researchers suspect that muscle is intimately involved in regenerating skin. The researchers centered a 2-centimeter-by-1-centimeter polymer patch on a 6-cm-by-6-cm area of uncovered muscle. They found that after 14 days, new dermis and epidermis had begun to develop even though the new skin was still more than 1 cm away from the surrounding healthy skin encroaching inward. This suggests that the new skin did not develop as an extension of existing skin, but as an extension of muscle, says Yannas.

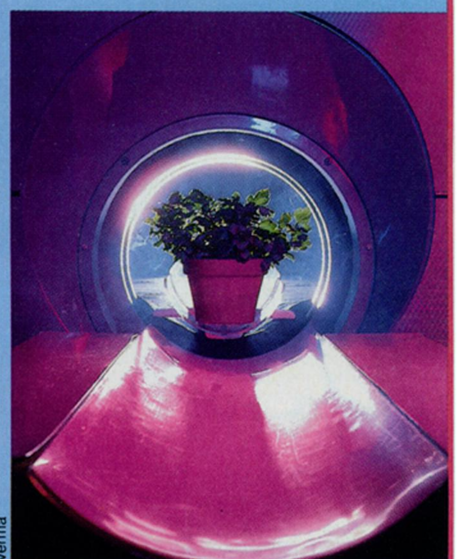
"It is unusual," he adds, "because [muscle and skin] are embryonically distinct. . . . It can be looked at as a very complex chemical reaction [in which] . . . one tissue is used to generate another using the matrix as a kind of catalyst."

While they do not yet understand how the regeneration mechanism works, the researchers do know that fibroblast and stem cells — which normally synthesize new connective tissue or are differentiated into other cellular forms — move from the muscle tissue into the polymer. They also have identified the polymer parameters that best encourage skin growth — for example, the membrane-pore size must fall within a particular range and the polymer can't degrade too quickly. For epidermal growth, at least 50,000 young epidermal cells per square cm must be injected into the membrane, which feels and looks much like a wet paper towel.

The researchers, working with rats, have also used the polymer matrix to regenerate sciatic (leg) nerves that had been cut 1.5 cm along their lengths (SN: 9/21/85, p.183). Yannas says the nerve and skin work in general suggest that with suitably designed polymer matrices, surgeons might one day be able to regenerate other tissues and organs that have to be cut out because they are diseased.

— S. Weisburd

You say tomato, they say tomography



Verma

Researchers at the Georgia Experiment Station in Griffin are using a novel technique for performing agricultural research. They are experimenting with the use of computer-assisted tomography, or CAT scan, to look at everything from root-mass growth to apple bruises. Their work represents the first time a CAT scanner — designed to perform detailed X-ray analysis of the human body — has been completely dedicated to agricultural research.

"We first used the CAT scanner at Emory University in Atlanta about three years ago," Brahm Verma, one of the researchers, told SCIENCE NEWS. "At first they were quite skeptical, naturally. Their primary perception was that we were probably going to mess up their machine."

But early success in imaging such things as root systems, plant pest distributions and water absorption patterns using large potted plants inspired the Experiment Station, which is operated by the University of Georgia, to acquire its own machine. "The scanner allows us for the first time to look at the same plant, the same soil system, day after day after day, without having to dig into the system," Verma says. "That is the real potential."

With the help of University of Georgia entomologist Joseph Cheshire, for example, the team has done studies with lead-impregnated pesticide granules in order to see how various tillage operations affect pesticide distribution. "The granules show up as pinpoints in the image," says colleague William Tollner. "So we're actually able to take soil samples and look at the profile to find out where these chemicals go in relation to the plant material and in relation to where the insects tend to be."

Another ongoing study has the CAT scanner detecting bruises on fruits and vegetables before the bruises become visible to the unaided eye (SN: 5/12/84, p.300). Verma and Tollner hope to discover at what point in the harvesting and distribution process most damage occurs. With that information, handling procedures can be improved or damaged produce can be removed from distribution before it is transported to market.

Also under examination in the Experiment Station's heavily shielded room: analyses of water uptake by different types of roots and a look at some of the finer details of soil-seed contact during seed germination. *— R. Weiss*