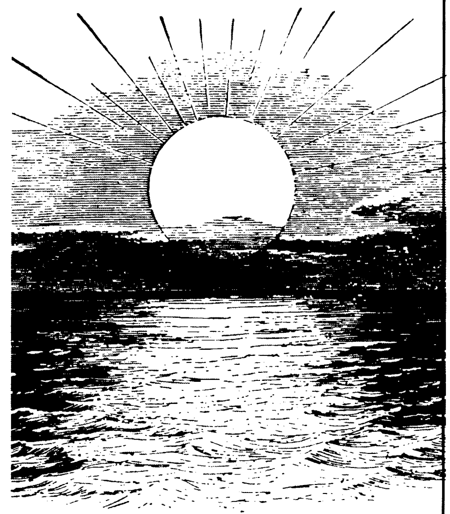
The dark side of sunlight: Skin cancer



Sun worshippers flocking to warmer climes this winter, take note: Researchers now know just how overdoses of sun can cause skin cancer.

Squamous cell carcinoma, a slow-growing skin malignancy, can usually be cured if properly treated. Yet like its cousin, the more virulent malignant melanoma, squamous cell carcinoma can kill if not removed quickly enough.

Indeed, the American Academy of Dermatology says this kind of cancer will cause about 1,500 deaths in the United States in 1994.

Researchers know that repeated exposure to the sun's damaging ultraviolet light can cause squamous skin cancer. To unravel the mechanism underlying that process, Douglas E. Brash of Yale University School of Medicine and his colleagues conducted studies on mice and precancerous skin tissue removed from humans. The group's data show that the tumor-suppressor gene p53 plays a key role in the genesis of squamous cell cancer.

The team began its inquiry by analyzing 45 samples of precancerous skin removed from 24 people. The condition, called actinic keratosis, appears as a raised tan or reddish splotch on the skin. These scaly areas often crop up on the face, the top of a bald head, or any other part of the body frequently exposed to sun.

If left untreated, such patches can progress to squamous cell cancer.

The researchers discovered that 60 percent of the premalignant skin specimens had mutations, or defects, in the p53 gene.

To explore p53's role in normal skin exposed to sunlight, the researchers turned to a mouse model. They irradiated the skin on the backs of normal mice with ultraviolet light. Twenty-four hours later, they discovered many "sunburned" cells — skin cells in the process of apoptosis, or programmed cell death.

The team describes its findings in the Dec. 22/29 NATURE.

The phenomenon is well known to people who have baked themselves on a sun-drenched beach. Sunburn first causes a burning sensation and only later leads to peeling skin. Brash's team believes that in normal skin cells, exposure to the sun first sets up a protective response. The ultraviolet light injures the DNA in skin cells, a process that activates p53, which then directs the cells to commit suicide. As the genetically injured cells die, they begin to slough off.

At least that's the way it's supposed to work. The trouble occurs when repeated exposure harms the p53 gene. When a cell with a faulty p53 gene gets zapped with ultraviolet light, it never gets the message to commit the cellular equivalent of hara-kiri.

Indeed, when the researchers exposed mice lacking this crucial gene to ultraviolet light, they found "hardly any" cells undergoing this ritualized death, Brash says.

Rather than die off, the cells that have sustained damage to their DNA survive and keep on dividing. Eventually, they become the premalignant skin splotches that can form the basis of a cancer, Brash says.

The results suggest a way to prevent progression from actinic keratosis to skin cancer. "If one could find a way to correct the p53 injury, then it's conceivable that you would be able to block the development of . . . skin cancer," says coauthor David J. Leffell, also of Yale University School of Medicine. Leffell hopes such a therapy could be applied directly to the skin in a cream or lotion.

For those who don't want their skin to travel that far along the malignant pathway, the researchers repeat some commonsense advice: Avoid sunburn, use sunscreen that blocks ultraviolet light, and avoid exposure to the sun during the skin-sizzling hours of midday. — *K.A. Fackelmann*

NASA identifies cause of ozone depletion

Some people call it a doomsday myth. Others say it's a real global threat. The debate about the destruction of Earth's protective ozone layer centers on whether man-made chemicals called chlorofluorocarbons (CFCs), used mainly in refrigeration and air conditioning, are eating it away.

According to the ozone-thinning theory, CFCs release chlorine into the stratosphere, the upper region of Earth's atmosphere, leading to ozone destruction and exposing the planet to harmful ultraviolet rays. Critics maintain that the chlorine in the atmosphere comes from natural sources such as volcanic eruptions and causes no permanent damage.

Now, NASA researchers say they have collected evidence that points a definitive finger at CFCs. On the basis of data gathered by the agency's Upper Atmospheric Research Satellite (UARS), they find hydrogen fluoride — a CFC by-product that has no natural source — present with chlorine in the stratosphere. NASA presented its findings at a Dec. 19 press conference.

"The detection of stratospheric fluorine gases, which are not natural, eliminates the possibility that chlorine from volcanic eruptions or some other natural source is responsible for the ozone hole over the Antarctic," says Mark Schoeberl, a NASA physicist on the UARS project.

Natural chlorine accounts for only about 20 percent of the chlorine found in the stratosphere, Schoeberl explains, because most of it dissolves in water and falls out as rain before reaching the ozone layer. In contrast, CFCs, which are insoluble, eventually rise to the ozone layer, where they can survive for decades. Once in the stratosphere, the CFC molecules break apart. Chlorine atoms attach to oxygen atoms and form chlorine monoxide, which erodes the ozone.

Global ozone loss reaches about 3 percent per decade, considered fairly significant by most scientists. The ozone hole that forms over Antarctica from May to October each year remains the clearest example of ozone depletion. Schoeberl and his colleagues attribute this phenomenon both to the CFCs and to the extreme cold of the region.

Schoeberl says NASA will continue to analyze the UARS data for indications of ozone depletion in other areas.

"UARS has seen high levels of chlorine monoxide in the Northern Hemisphere," says Schoeberl, "but with the warmer temperatures, the high levels do not last as long over the Arctic." Low temperatures and sunlight are key parts of the chemical reaction that allows CFCs to attack the ozone, he explains, making the dramatic ozone loss seen over the South Pole unlikely elsewhere."

NASA launched UARS in 1991 to compile a database about Earth's atmospheric chemistry, processes controlling ozone in the stratosphere, the effect of the sun's radiation on the atmosphere, and other atmospheric phenomena.

— *A.C. Brooks*

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