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REPORT

Why Sunscreens Do Not Fully Prevent Skin Cancer

By Dale Kiefer



For decades, the public has been told that sunscreens help guard against skin cancer.

One would think that a lotion that reduced solar ray penetration would be protective. Recent scientific studies, however, suggest that sunscreen use may not reduce the risk of melanoma, the deadliest of skin cancers.¹

Commercial sunscreens fail to adequately protect the skin because they have little impact on reducing the free radicals generated in response to solar radiation exposure. One study showed that an SPF 20 sunscreen provided a “free radical protection factor” of only 2!² In other words, while sunburn-inducing ultraviolet-B rays can be blocked, other kinds of solar radiation continue to inflict DNA damage that can result in skin cancer.^{2,3} These same free radicals also contribute to skin aging.^{3,4}

Since 1983, the Life Extension Foundation has maintained that it takes more than conventional sunscreens to protect the skin from DNA-damaging solar rays. The encouraging news is that an abundance of newly published data provides a basis for enhanced skin protection against ultraviolet light that greatly exceeds what is available in commonly used over-the-counter sunscreens.

Considering that skin cancer (malignant melanoma, basal cell carcinoma, and squamous cell carcinoma) is the cancer with the highest incidence worldwide, those who follow obsolete recommendations are setting themselves up for lethal disease or premature aging of the skin.⁵

In this article, Life Extension challenges conventional wisdom about how you can protect yourself against damaging solar rays. Alternatives to outmoded, topical sun-blocking agents are provided.

Misconceptions can be deadly. If you think you can safely lie out in the sun as long as you are covered with a commercial sunscreen, the science indicates you are mistaken. Increasingly, studies suggest that no commonly available sunscreen prevents photodamage.³



Even if you choose to avoid sunbathing, typical everyday exposure (30 four-minute exposures over the course of a week) is equivalent to spending over two hours every week at the beach. In fact, everyday sun exposure is a causative factor in skin aging.^{2,4}

With the onset of the long, sunny days of summer and the ongoing depletion of the Earth's protective ozone layer, protecting your skin against solar radiation should be a priority. As the incidence of skin cancers and premature aging of the skin continues to increase to epidemic levels, taking aggressive steps to guard against sunlight-induced free radicals is of paramount importance.

An estimated 90% of all skin cancers result from long-term exposure to UV radiation from the sun.⁶ Fair-skinned Caucasians and redheads, usually of northern European descent, are at highest risk of suffering UV-induced damage.

MELANOMA INCIDENCE RISING

Melanoma is highly treatable when detected and treated early. It is also largely preventable, if you scrupulously avoid sun exposure throughout your life. However, studies show that Americans have received up to 50% of their lifetime dose of UV radiation by the time they reach the age of 21.⁷ If you are of Caucasian descent and a certain age, you likely are at increased risk of developing this dangerous cancer of the skin's pigment cells, which are known as melanocytes.

In fact, according to the National Cancer Institute, the incidence of skin melanoma among Caucasians in North America has steadily increased for about the last 30 years. Diagnoses increase dramatically after the age of 50, especially among men.⁸ Scientists at the Boston University School of Medicine report that in the US, melanoma diagnoses are increasing at a rate faster than those of any other preventable cancer.⁹

The American Cancer Society estimates that the mortality rate from melanoma has increased 50% since 1973. While the annual rate of increase has slowed somewhat since the early 1980s, nearly 60,000 new cases are expected to be diagnosed this year, and nearly 8,000 Americans will die of the disease.¹⁰ Those statistics pertain only to melanoma, the deadliest of skin cancers. If we also include basal cell and squamous cell carcinomas (two less deadly but still worrisome cancers of the epidermis), various skin cancers account for more than 50% of all cancer cases.

Melanoma may be deadly, but basal and squamous cell carcinomas are considerably more common. In fact, “Basal cell carcinoma is as common as dirt,” says Dr. Brett Coldiron, an expert on skin cancer treatment. Basal and squamous cell carcinomas respond well to relatively simple treatment, but repeat carcinomas likewise are common.

WHY TANNING IS DAMAGING

Tanning results when melano-cytes generate pigment in an apparent effort to protect the skin. Efficiency at pumping out melanin confers darker skin, and darker skin traditionally has been associated with greater protection from the sun, primarily because darkly pigmented skin is at lower risk of photocarcinogenesis, or UV-induced cancer. By the time a tan develops, however, tissue damage has already occurred.

Recently, some scientists have suggested that melanin production is triggered by DNA damage and subsequent cellular efforts to repair that damage. According to this hypothesis, photoprotection against the redness and DNA damage caused by UV exposure does not correlate with level of skin pigmentation; instead, darker-skinned Caucasians may simply be better at repairing damage than are lighter-skinned individuals.¹¹ Growing public awareness of the dangers of a “healthy tan”—and of the importance of regular use of sunscreen with a sun protection factor (SPF) of 15 or greater, in combination with skin-protective phytochemicals—may help to slow the incidence of skin cancer.



NEW, IMPROVED ZINC OXIDE

Various chemicals act as UV screens, and commercial sunscreen products may incorporate several of these to achieve a given SPF level. One of the oldest, best-known sunscreen agents is zinc oxide. Although perhaps none-too-fondly recalled as a white paste sported by lifeguards at the beach, zinc oxide has come a long way in recent years. New manufacturing processes can produce zinc oxide with microfine particles that block UV radiation effectively while appearing invisible on the skin.^{12,13} The FDA classifies microfine zinc oxide as a Category I skin protectant.

Also important for immune health is inorganic zinc, which is found in at least 300 proteins, hormones, and enzymes,¹⁴ including one of the body’s most important natural antioxidants, superoxide dismutase (SOD).^{15,16} Topical zinc apparently promotes healthy skin by at least two mechanisms besides UV protection. Animal studies have shown that topical zinc oxide prompts the release of insulin-like growth factor and increases the mitotic index of basal cells, while also promoting wound healing.^{17,18} The mitotic index measures the rate at which cells divide in order to repair tissues.

TITANIUM DIOXIDE

Like zinc oxide, titanium dioxide is an inorganic metal. While previous research suggested that these micronized oxides act as physical sun shields by scattering or reflecting UV light, recent findings suggest that zinc oxide and titanium dioxide mobilize electrons within their atomic structure while absorbing UV radiation.¹³ Thus, while these agents are not inert as was previously assumed, they are still safe, stable, non-toxic, and highly efficient sunscreens.¹³ Titanium dioxide offers a high level of protection against both UVA and UVB radiation, and scientists report that “products containing microfine titanium dioxide are likely to offer superior photoprotection.”¹⁹

OCTINOXATE AND OXYBENZONE



Octinoxate and oxybenzone are highly efficient ultraviolet shields that the FDA has qualified as Category I sunscreens. These compounds primarily offer protection against UVB waves. Investigators have found that octinoxate, also known as octyl methoxycinnamate, protects the skin against not only sunburn but also UV light-induced DNA alterations.^{20,21} Titanium dioxide also demonstrated this DNA-protective effect.²¹ When scientists compared the efficacy of several sunscreen agents, they found that preparations containing oxybenzone yielded the highest SPF values.²² Thus, octinoxate and oxybenzone may help protect against UV-light induced DNA changes and boost the SPF of sunscreen products.

Sunscreen agents including transparent microfine zinc oxide, titanium dioxide, octinoxate, and oxybenzone are clearly a boon to sun worshipers. For some people, however, the judicious use of sun blockers may simply be too little, too late, as sun damage is cumulative.²³ Skin can be thought of as a kind of radiation dosimeter, such as an X-ray technician might wear. Although daily exposure may be minimal, invisible damage accumulates gradually. Like the X-ray technician, we need to keep cumulative dosage in mind when venturing into the sun.

SUNSCREEN: HOW MUCH, HOW OFTEN?

A sunscreen with an SPF of 15 should prevent sunburn from an all-day exposure to tropical sunlight. Behavioral studies show, however, that sunscreens of SPF 15 or greater do not always prevent sunburn.²⁴ Several factors may account for this discrepancy in sun protection, including the type of sunscreen applied, resistance to water immersion and sand abrasion, and how often sunscreen is reapplied.

A number of studies suggest that many people do not use enough sunscreen to obtain maximum sun protection. The FDA determines the SPF of a sunscreen based on an application thickness of 2 mg/cm². A study from Denmark showed that when 42 volunteers on a beach applied their own sunscreen all over their bodies, the average amount applied was only 0.5 mg/cm², or one quarter of the recommended amount.²⁵ The application thickness of sunscreen has a significant effect on its sun protection factor. In fact, an English study showed that most people apply only enough sunscreen to achieve 20-50% of the sun protection factor expected from the product label.²⁶ Underprotection due to inadequate application may explain the reports suggesting that sunscreen use is a risk factor for melanoma.²⁶

While ample application of sunscreen is important, consistent daily use may be just as critical. Researchers from Boston and Cincinnati examined the effects of daily versus intermittent sunscreen application in preventing skin damage. Twenty-four subjects were exposed to two daily doses of UV radiation for four consecutive days. Three sunscreen products were applied to areas of each subject's skin. A product with an SPF of 15 was applied daily before UV exposure.

To simulate intermittent product use, an SPF-15 product or SPF-29 product was applied to another area on three of the four days, with one missed application on days two, three, or four. The researchers found a significant increase in inflammation and sunburn in the intermittently protected areas compared to skin that was not exposed to UV light and skin that was treated daily with the SPF-15 product. The researchers concluded, "daily use of a sunscreen reduces the skin damage produced by UV exposure compared with intermittent use of equal or higher SPF products. The daily application of sunscreens in appropriate quantities reduces the harmful effects of solar UV radiation on skin."²⁷



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WHAT ABOUT VITAMIN D?

Some health authorities have recently suggested that the campaign to encourage rigorous use of sunscreen may have an unforeseen side effect: an increase in vitamin D deficiency. It is true that occasional sun exposure is important for the body's manufacture of vitamin D.²⁸⁻³⁰ In fact, 90-100% of the body's requirement for vitamin D can be obtained by the action of UV light striking exposed skin.³¹ It is also well established that adequate vitamin D is essential for good bone health. Some scientists have even proposed that sunlight exposure confers a measure of protection against certain cancers—including, paradoxically, melanoma,³² possibly due to sunlight's role in helping the body manufacture vitamin D.^{30,31}

This issue, however, remains controversial. Dr. Coldiron believes that approximately 15 minutes of unprotected sun exposure per week is sufficient to meet the body's requirements, given the level of vitamin D fortification in the food chain. Michael F. Holick, MD, PhD, a professor of medicine, physiology, and dermatology at Boston University Medical Center, agrees. In an article published in *The American Journal of Clinical Nutrition*, Dr. Holick writes: "Sensible sun exposure (usually 5-10 minutes of exposure of the arms and legs, or the hands, arms, and face, 2 or 3 times per week) and increased dietary and supplemental vitamin D intakes are reasonable approaches to guarantee vitamin D sufficiency."³³

While UV-mediated vitamin D manufacture is efficient, this important vitamin can also be obtained through dietary sources and supplements. Vitamin D is present in fatty fish, which likewise provide healthful omega-3 fatty acids, and as a dietary supplement and food additive. However, skin cancer is far more common than rickets, the soft bone disease that can result from vitamin D deficiency.³⁴ Many aging baby boomers suffered severe sunburns as children, which places them at significantly greater risk of developing skin cancer as they approach the age of 50 and beyond.

Routinely applying sunscreen with an SPF of 15 or greater—and carefully re-applying it according to the manufacturer's instructions—is essential to helping prevent skin cancer and premature skin aging. Although SPF represents the beginning of the modern sun-protection story, it is certainly not the end. As one team of scientists recently declared in the peer-reviewed medical journal *Cutis*, "Even those products with a very high sun-protection factor (SPF) and full-spectrum UVB and UVA protection may not prevent UV radiation-induced [damage to the immune system]."³⁵



Green Tea

Recent research on cancer-fighting phytochemicals—potent, biologically active compounds derived from plants—indicates that a more proactive approach to skin health may be in order. By combining a variety of beneficial compounds with more mundane sun-blocking agents, it is possible to protect the skin from damage and actively repair some damage that already may have occurred.

BENEFITS OF TOPICAL GREEN TEA

Scientists have recently focused on several remarkable compounds that offer protection against photoaging and photodamage. Chief among these naturally occurring chemicals is epigallocatechin gallate (EGCG), a catechin polyphenol compound found in green tea. Studies have shown that EGCG provides broad-spectrum protection by preventing three of the pathological changes associated with sun damage: inflammation, DNA damage, and immune system deficits.^{36,37} According to one leading researcher, "Animal and human studies suggest that green tea polyphenols are photoprotective in nature."³⁸

Inflammation normally results with the exposure of skin to UV radiation. White blood cells known as leukocytes stream into irradiated tissues. Oxidative damage occurs and produces free radicals, thereby depleting immune system cells. Numerous studies have found that topical application of green tea extract prevents these pathological changes.³⁸⁻⁴⁵ As a result, researchers believe, green tea may prevent skin cancers that would normally be induced by exposure to solar radiation.³⁸⁻⁴⁵ Indeed, experiments on mice specially bred for their susceptibility to skin cancer demonstrate that topical application of green tea extract reduces tumor incidence and size following exposure to measured amounts of UV radiation.^{42,46} A leading dermatology research team concluded, "Treatment with EGCG . . . resulted in exceptionally high protection against photocarcinogenesis . . ." ⁴²

Green tea's benefits do not stop there. More recently, scientists examined green tea's effects on normal, healthy skin in aging humans. Topically applied green tea extract stimulated the proliferation of skin cells known as keratinocytes. The increase in

these structural support cells led to an increase in epidermal thickness, and subsequent UV exposure failed to destroy the cells, as would normally occur. Two of the hallmarks of aging skin are reduced thickness and keratinocyte destruction. Green tea reversed both of these markers of skin aging. The researchers concluded, "This study demonstrates that EGCG promotes keratinocyte survival and inhibits the UV-induced [cell death] via two mechanisms . . ."47

Earlier this year, researchers in England published the results of experiments in which human cell cultures were exposed to UV radiation with or without the presence of EGCG. Cells treated with the green tea compound experienced significant protection from UV-induced DNA damage. Scientists believe such damage may underlie the eventual development of cancer; it is likewise implicated in the development of visible signs of aging. Taking things a step further, human subjects were given green tea to drink, and their blood was collected before and after tea drinking. The blood cells were subsequently irradiated with UVA radiation. Blood cells drawn from subjects who drank green tea experienced significant protection from UV damage compared to those drawn before tea drinking.³⁷

SKIN CANCER STATISTICS

Currently, a raging epidemic of cancer relentlessly kills one person every single hour of every single day.* While breast cancer and lung cancer quickly come to mind as contenders for the leading cancer killer, it is actually skin cancer that needlessly claims so many lives. Each year brings more new cases of skin cancer than cases of breast, prostate, lung, and colon cancers combined.* Yet skin cancer is largely preventable, and with a few easy steps, more than 60,000 needless deaths a year could be prevented.*

The statistics on skin cancer are nothing less than frightening:

- more than 1 million people will be diagnosed with skin cancer this year*
- more than half of all new cancers are skin cancers*
- one in five Americans will get skin cancer during their lifetime*
- melanoma kills more young women than any other cancer*
- there are more new cases of melanoma than of HIV/AIDS**
- the past 30 years have seen no significant advances in medical therapies or survival for patients with advanced melanoma**
- in national skin cancer screenings, 44% of those found to have melanoma are white men over the age of 50*
- the incidence of eye melanomas among white males increased 295% between 1973 and 1999*
- more than 90% of all skin cancers are caused by sun exposure, yet fewer than 33% of adults, adolescents, and children routinely use sun protection.*

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* Available at: <http://www.skincancer.org/skincancer-facts.php>. Accessed April 11, 2005.

** Available at: http://www.melanoma.org/mrf_facts.pdf. Accessed April 11, 2005.

SILIBININ, SILYMARIN ARE ALSO PROTECTIVE

The milk thistle plant (*Silybum marianum*) is another source of beneficial compounds. Silibinin and silymarin, flavonoid compounds extracted from milk thistle, have well-established antioxidant, anti-inflammatory, and immune-enhancing properties. Used clinically to treat liver toxicity in Europe and Asia, milk thistle flavonoids also combat carcinoma of the prostate and lungs, as well as other cancers.⁴⁸⁻⁶⁰

Aware that many antioxidants guard against tumor promotion, scientists at Case Western Reserve University wondered whether silymarin might also protect against skin cancer. In the late 1990s, they tested this hypothesis on mice bred for their susceptibility to skin cancer. After topical application of silymarin, scientists exposed the mice to chemical carcinogens known to elicit tumors. Tumor incidence, multiplicity, and volume were all reduced significantly. According to the research team, "These results suggest that silymarin possesses exceptionally high protective effects against tumor promotion . . ."49



Milk Thistle
(*Silybum Marianum*)

In the last few years, similar research has confirmed and expanded on these findings. Scientists at the University of Colorado reported that silibinin, a major constituent of milk thistle, significantly reduced skin tumor multiplicity and volume when applied to the skin of mice bred to serve as a model of UV-induced human skin cancer. Tumor incidence was decreased moderately, and the mechanisms underlying these protective effects were elucidated. According to the researchers, “Together, these results show a strong preventive efficacy of silibinin against photocarcinogenesis, which involves the inhibition of DNA synthesis, cell proliferation, and cell cycle progression, and an induction of apoptosis.”⁵²

Working with cultures of skin carcinoma cells, researchers examined the effects of EGCG and silibinin on molecular signaling events involved in the rampant proliferation of the aberrant cells. While treatment with both phytochemical agents resulted in “strong dose- and time-dependent cell growth inhibition,”⁵⁷ the scientists noted that cancer-preventive effects were achieved through different molecular mechanisms—a finding that supports combining photoprotective phytochemicals for maximum efficacy.

Because milk thistle flavonoids prevent skin cancer through various mechanisms and are well tolerated, they are a natural choice for inclusion in broad-spectrum sunscreen formulations. “Silymarin may favorably supplement sunscreen protection and provide additional anti-photocarcinogenic protection,” wrote a leading researcher earlier this year.⁴⁸

GRAPE SEED POLYPHENOLS AND PROANTHOCYANIDINS

Resveratrol, which is found in grape seeds and skins, has been hailed as a remarkable compound capable of exerting a wide range of beneficial effects and extending life span in a variety of organisms.^{61,62} Scientists classify resveratrol and related compounds as phytoalexins: natural antibiotics designed to protect a plant from attack by pathogens. Researchers also believe that resveratrol protects plants from UV damage. For instance, grapes grown at higher altitudes, where UV exposure is greater, tend to contain greater amounts of resveratrol.⁶³

Another class of beneficial compounds concentrated in grape seed, the antioxidant proanthocyanidins, inhibit skin chemical carcinogenesis and photocarcinogenesis in mice through at least three pathways.⁶⁴⁻⁶⁷ Proanthocyanidins have demonstrated antioxidant power that is 20 times greater than that of vitamin E and 50 times greater than that of vitamin C. These powerful phenolic compounds protect the skin against sun damage while promoting the elasticity, flexibility, youthfulness, and health of skin cells.⁶⁷

TURMERIC ROOT EXTRACT

Throughout history, the curry spice turmeric (*Curcuma longa*) has been valued as both a culinary and medicinal agent. Curcumin, a yellow pigment derived from turmeric root, exhibits antioxidant and anti-inflammatory effects, and may help promote wound healing.⁶⁸ In an experimental animal model, topical curcumin application inhibited the initiation and promotion of skin tumors.⁶⁹

While these and other studies suggest that topical curcumin may benefit the skin, curcumin’s yellow color makes it undesirable as a cosmetic agent. Fortunately, researchers have developed a colorless derivative of turmeric root called tetrahydrocurcumin that may allow people to benefit from this spice without undesirable cosmetic effects. Topical application of tetrahydrocurcumin helps to quench existing free radicals and prevent the formation of new ones. This dual action protects skin cells from UV light-induced damage and resulting inflammation and skin injury.⁷⁰

Laboratory studies indicate that topical tetrahydrocurcumin is a safe and effective skin-lightening agent.^{71,72} Skin-lightening agents help to fade sun-induced areas of hyperpigmentation, or skin darkening. Many such agents work by inhibiting tyrosinase, a key enzyme involved in melanin synthesis. Thus, the colorless turmeric root derivative tetrahydrocurcumin may help protect the skin against detrimental effects of UV light and may help prevent (or fade) hyperpigmented areas of skin. While hyperpigmentation is not a medically harmful condition, it is always advisable to have a physician examine new brown spots to rule out skin cancers.

REPORT

Why Sunscreens Do Not Fully Prevent Skin Cancer

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LICORICE EXTRACT AND ROSEMARY

Licorice, derived from the roots of *Glycyrrhiza glabra*, has been used medicinally for more than 4,000 years. Modern science has confirmed that licorice is a powerful skin protectant. Numerous studies suggest that licorice extract protects the skin from the damaging effects of UV light.^{73,74} Licorice extract also has demonstrated efficacy in treating atopic dermatitis, an allergy-related, intensely itchy swelling of the skin.⁷⁵

In animal studies, a preparation containing 0.5% glabridin, one of the primary active constituents in licorice extract, prevented the redness and inflammation normally associated with UV exposure when pre-applied to the skin. Licorice extract also reduces melanin synthesis.⁷⁴ Recent research suggests that UV-induced DNA damage and subsequent repair efforts precede melanin synthesis.¹¹ Furthermore, licorice extract's antioxidant activity has been shown to enhance the stability of other compounds when added to a topical dermatological cream.⁷⁶ This antioxidant activity evidently protects skin against damage caused by free radical and reactive oxygen species.⁷³



Licorice (*Glycyrrhiza Glabra*)

Rosemary (*Rosmarinus officinalis*), a fragrant evergreen perennial herb, has been used as a seasoning and medicinal herb for several millennia. Rosemary contains numerous beneficial compounds, including cancer-fighting chemicals, antioxidants, and anti-inflammatory agents.⁷⁷⁻⁷⁹ At least two of these, carnosic acid and ursolic acid, are especially beneficial to skin.⁸⁰⁻⁸² Application of rosemary extract has been shown to prevent chemically induced skin tumors in a mouse model of human skin cancer. Depending on the concentration of the extract, tumors were inhibited by up to 99%.⁸⁰



Rosemary (*Rosmarinus Officinalis*)

Earlier this year, French researchers demonstrated that ursolic acid, derived from rosemary, significantly inhibited the proliferation of melanoma cells in culture, apparently by promoting apoptosis (programmed cell death).⁸² More than a decade earlier, Rutgers University scientists demonstrated that in a mouse model of human skin cancer, both carnosic and ursolic acids markedly inhibit tumor growth when applied to the skin.⁸⁰ Korean scientists have shown that "ursolic acid significantly suppressed the UVA-induced reactive oxygen species production and lipid peroxidation" in a human keratinocyte culture. They concluded that ursolic acid "may be useful in the prevention of UVA-induced photoaging."⁸³ In addition, research has demonstrated that when specially formulated with lipids, ursolic acid enhances the dermal collagen and ceramide content of normal human epidermal keratinocytes.^{84,85} Collagen provides the "skeleton" that gives shape and structure to the skin, while ceramide is a lipid that helps maintain proper immune function, as well as youthful moisture content, in the skin. Keratinocytes make up as much as 95% of epidermal tissues and are responsible for producing keratin, the tough protein that contributes to healthy hair, nails, and skin.

CONCLUSION

When it comes to protecting yourself against skin cancer, the most common of cancers worldwide, sunscreen agents such as zinc oxide alone may not be enough. While sunscreens can help shield against UV light-induced sunburn, it is crucial to also protect the skin against the free radicals generated by solar radiation. Left unchecked, these notoriously harmful agents may contribute to skin aging, DNA damage, and skin cancer.

Fortunately, a number of powerful plant-derived phytochemicals may help protect the skin via novel mechanisms that are distinct from those provided by sunscreen agents. Emerging evidence suggests that topically applied botanicals—including green tea, milk thistle, grape seed, turmeric root, licorice root, and rosemary—may prevent deleterious effects from sun exposure such as inflammation, DNA damage, immune deficits, skin aging, and cancer. The potent antioxidant properties of these plant extracts may account for their skin-protective actions.

The combination of sunscreen agents with botanical extracts may thus provide the most complete protection against the harmful effects of UV light, by both screening solar rays and preventing the formation of damaging free radicals. These combinations offer promise not only in helping to guard against skin cancers but also in promoting healthy, youthful skin.

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