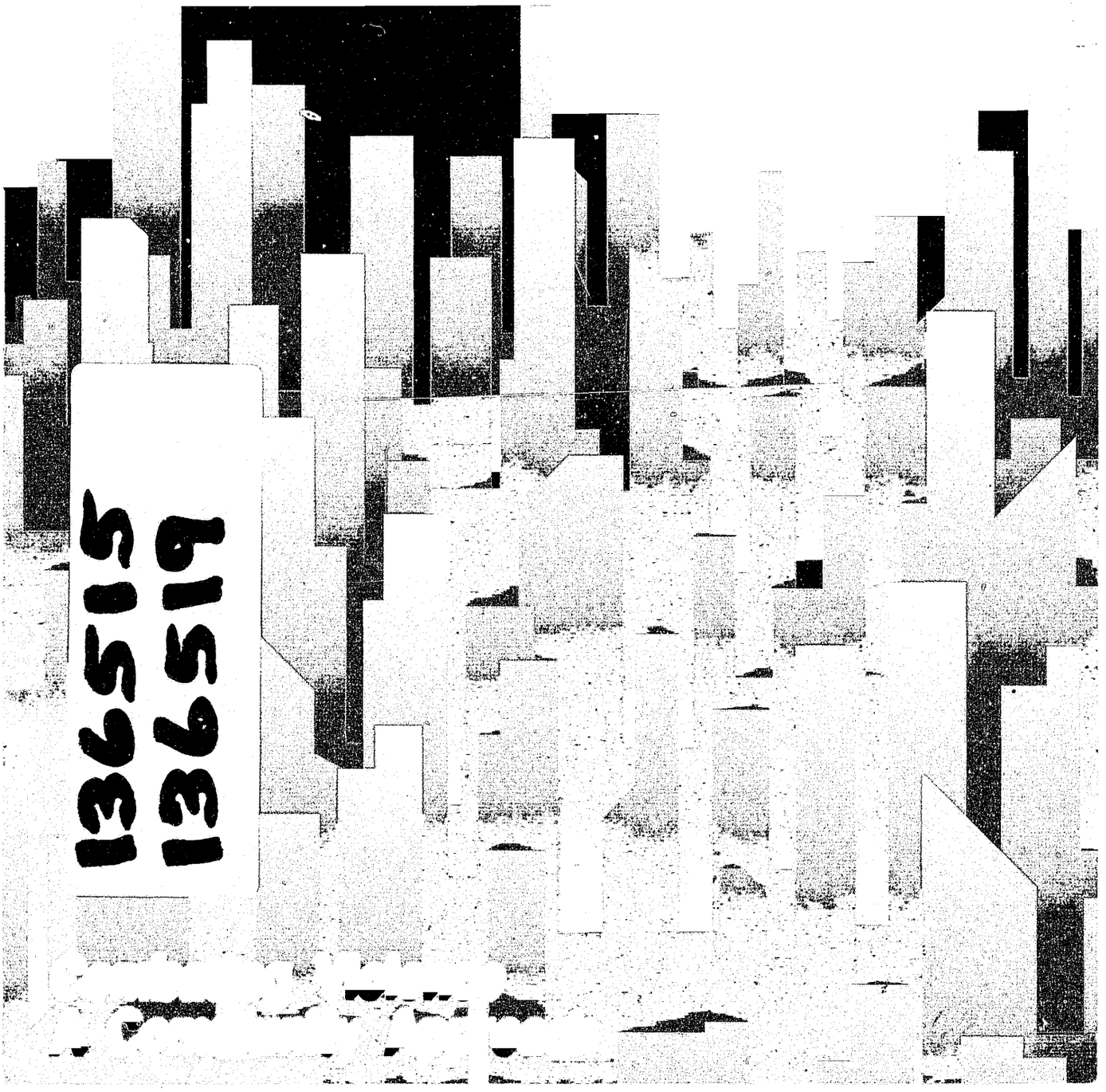

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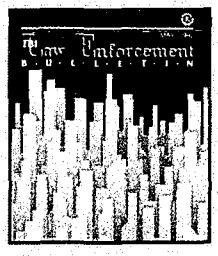

Cover: *This issue focuses on the need for police and citizens to join together to fight the violence that plagues communities across this Nation.*

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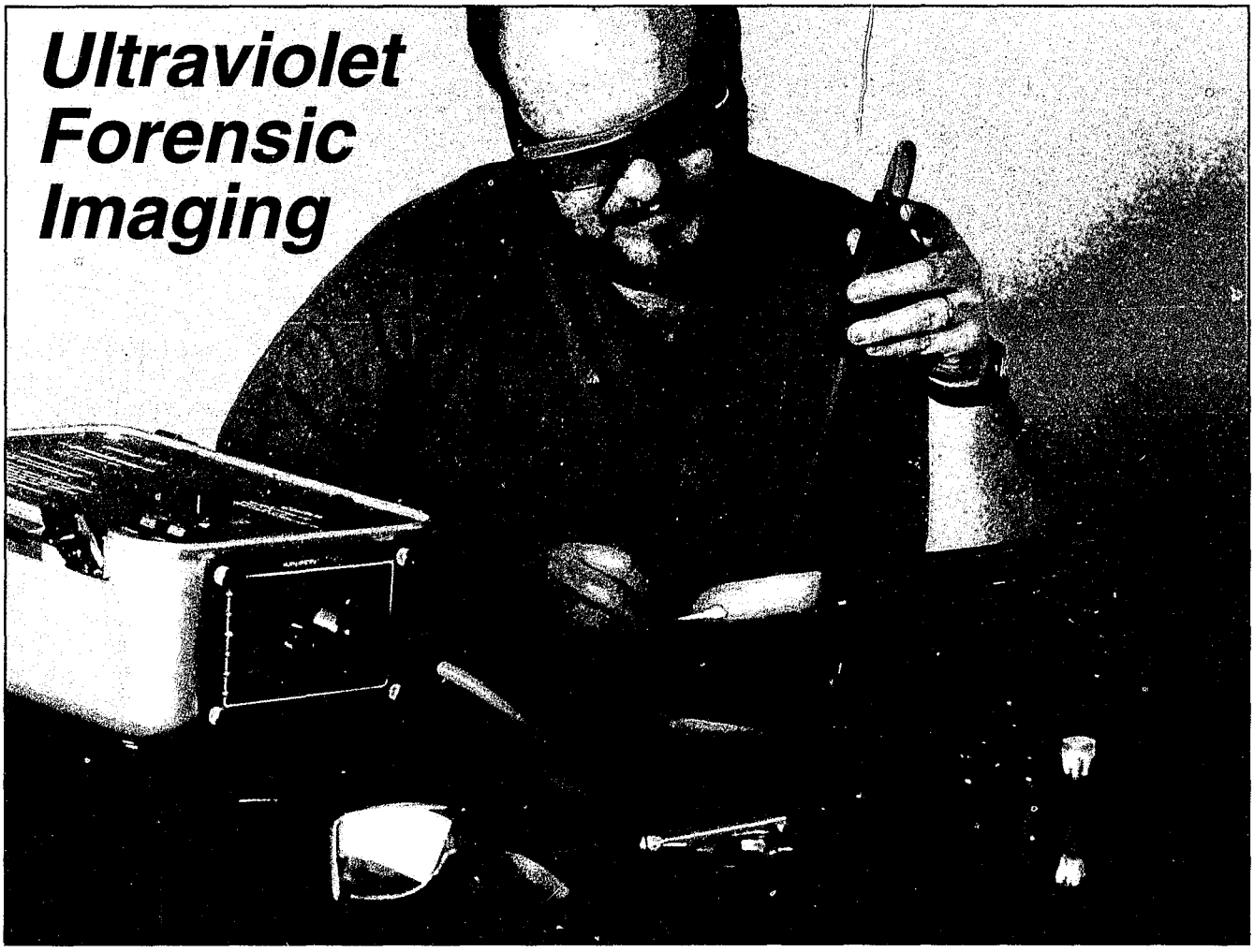
Ultraviolet Forensic Imaging



By MICHAEL H. WEST, D.D.S.
and
ROBERT E. BARSLEY, D.D.S., J.D.

Imagine the same ultraviolet rays that cause people to get sunburns in the summer also helping to catch and prosecute criminals. Researchers are discovering that these rays can literally "cast a new light" on evidence that might not even be detected using conventional investigative techniques. While ultraviolet (UV) technology is still in its early stages, it has already helped to solve crimes and is proving to be a significant development in the field of forensic research.

Ultraviolet Light

The word "ultraviolet" means simply "beyond violet." Think back to high school science classes about the rainbow. Its colors are merely the sun's white light split by a prism. At the top of this spectrum is red, followed by orange, yellow, green, blue, indigo, and finally, violet. The next tint in the prism would be ultraviolet, but our eyes cannot see this color. However, photographic equipment can visualize the ultraviolet spectrum quite well.

Uses of Ultraviolet Light

How can ultraviolet or "invisible" light be used in law enforcement? One application is in the analysis of bite marks on human skin. In searching for better ways to photograph bite marks, it was discovered that ultraviolet light provides more detail and contrast to an injured area than standard lighting techniques. This discovery led to the development of two techniques for ultraviolet photography.

In one method, known as reflective ultraviolet imaging, the wound

is flooded with UV light, and the reflected ultraviolet image is photographed. An ultraviolet bandpass filter mounted on the camera lens blocks all light returning to the film except UV. Proper film selection ensures that only the UV light rays reach the film. Many powerful electronic flashguns produce sufficient ultraviolet illumination for this process.

In the second method, called fluorescent ultraviolet imaging, the wound is flooded with only UV light. However, a different filter is used to block all UV rays returning to the camera so that only the visible light colors fluorescing from the wound will be captured on the film. This type of fluorescent photography must be performed in darkness.

Results

The results have been surprising. Thus far, the photos produced by the reflective ultraviolet imaging method have proven most useful. These photographs show wounds in greater detail than would be possible with conventional photographic equipment and reveal images of wounds that could not be seen by the naked eye.

Certain qualities of UV light make these results possible. Because ultraviolet light waves are very short (only a few millionths of 1 millimeter), their maximum penetration into human skin is usually less than that of visible light. (Due to variations in skin pigmentation, thickness, and other tissue factors, the penetration of UV can vary by up to 1.5 millimeters.) Because of this limited range, wounds that are deeper than 1.5 millimeters will only rarely be revealed in ultraviolet light. Still, though UV light waves

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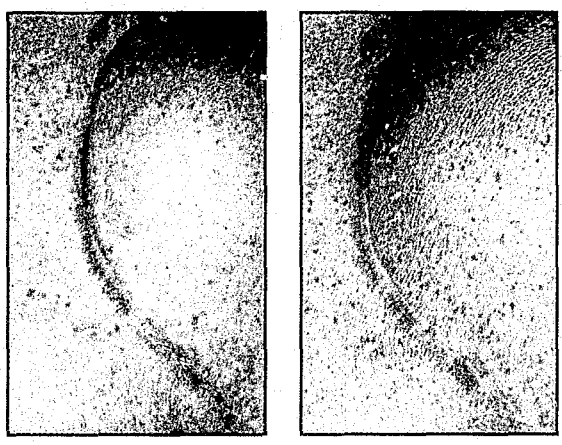
Bite Marks and Ultraviolet Light

When a bank executive failed to report for work, concerned co-workers went to her home. They were horrified to discover her raped and beaten body. During the postmortem examination, the pathologist noticed a bruised area on the left breast. Suspecting that it might be a bite mark, he requested that a forensic dentist examine the wound. The dentist confirmed that it was a bite mark, but only after developing ultraviolet photographs that showed the wound in detail, which allowed a comparison to be made with the suspect's dental records. The comparison revealed a match. When confronted with this evidence, the suspect pled guilty.

In another case, a woman was blindfolded, beaten, and raped in her home. She did, however, manage to bite one of her attackers on the arm during the assault. During the ensuing investigation, the victim's husband became a suspect, and an examination of his arm under ultraviolet light revealed a wound. Although he maintained that it was a scar from an earlier injury, the forensic dentist proved that it was a bite mark. The bite mark pattern was then duplicated, using an inked model of the victim's teeth on an anatomically correct arm. The suspect was subsequently convicted by a jury of participating in the attack.



On the left is a normal photograph of a surgical scar. On the right is a reflective ultraviolet imaging photograph of the same scar. The faint puncture wounds created by the suture needle are revealed only in the second photograph.

are short, they are very intense. Therefore, any pigmentation, wound pattern, or bruises on the surface of the skin, no matter how faint, will be revealed.

Linking Technologies

Although preliminary results of UV photography were very encouraging, limitations to its usefulness as a forensic tool soon became apparent. Potentially valuable physical evidence, such as minor wounds that could not be seen without enhancement, was being overlooked. Because investigators had no indication of these trace injuries, they did not request UV photography, which could have revealed the injuries in greater detail. Therefore, a system was needed to provide an ultraviolet scan of victims so that investigators could "see" any injuries or marks that would otherwise be missed.

A solution was developed by combining several technologies. A video intensifier tube, which is sensitive to light waves from the ultraviolet spectrum through the infrared, was modified to detect only ultraviolet light waves. With the modification, the ultraviolet image is intensified over 70,000 times. The resulting images are displayed on a video screen contained within the device, which can be linked to other video equipment, such as a standard video cassette recorder (VCR), a graphics computer, or a conventional camera for still photographs.

Use of the intensifier and VCR allows investigators and forensic researchers to visualize an ultraviolet image immediately, without waiting for film to be developed. The entire body of a victim can be scanned to highlight injury patterns that might otherwise go unnoticed. The equipment also vastly enhances the quality of still photographs, since the hand-held spotlight provides uniform illumination of the skin's surface.

Additional Uses

While the intensifier has proven very valuable in the detection and analysis of bite mark injuries, its value to crime scene investigators goes far beyond this application. The device has been used to scan entire crime scenes after the areas have been searched by technicians and investigators. Additional evidence, including footprints, fingerprints, and trace metal fragments missed during the initial search, was revealed in the ultraviolet scan. This evidence is then documented and photographed in the conventional manner.

Other aspects of crime scene and suspect investigations have been enhanced through the use of the intensifier. In one case a suspect reportedly shot himself when challenged by a police officer. The officer stated that the victim grabbed his pistol in a reverse grip, and using his thumb as the trigger finger, shot himself in the heart. The victim's family, however, claimed that he had been shot by the officer.

Using the trace metal reagent and ultraviolet illumination, the forensic examiner was able to illustrate graphically the pattern of metal contact from the pistol to the hand of the shooter. Analysis proved that the victim held the gun and shot himself. Marks on the trigger thumb and on the palm of the hand used to steady the gun documented in every detail the officer's version of the incident.

Conclusion

The limits of this technology remain unknown. However, case evidence illustrates the value of ultraviolet technology to law enforcement. Ultraviolet light allows investigators and forensic researchers to examine clues and recover evidence that could not have been detected previously. While the application of ultraviolet light is still a relatively new field, it promises to be an indispensable tool for law enforcement. ✦