Letters to the Editor

Commentary On: Golden GS. Use of alternative light source illumination in bite mark photography. J Forensic Sci 1994;39(3):815–23.

Sir,

Dr. Greg Golden is to be commended for his work referenced above on the "Use of Alternate Light Source Illumination in Bite Mark Photography." His research is a significant contribution to forensic science by confirming that its use enhances photographs used for wound pattern (bitemark) analysis. This technique of using an excitation source of blue light and studying the fluorescent properties of structures was first described in 1853 by Stokes (Stokes' Shift, Stokes' law) (1) and was studied and used in other areas of science (2–8). It is emerging in the forensic community for photographing wound patterns and bitemarks (9–11). It is important that this valuable technique continue to grow in use and acceptance, and therefore it is necessary to clarify the use of Dr. Golden's term for the excitation energy.

The reader might be confused by Dr. Golden's description of the technique's light source. The abstract and discussion says "450 nanometer visible blue light," the conclusion "450-nm alternate monochromatic light," and the body as "long wave (450 nanometer) ultraviolet blue light." Herein lies a dilemma facing this field of photography now in forensic use. There needs to be a standardization of the nomenclature so we are all using the same terms with the same meaning. We need to decide if we are speaking in terms of physics or photography. For instance the term "monochromatic" in terms of physics means one wavelength, as in all the photons are of the same wavelength. A Neodymium Yag laser emits monochromatic light that is 532.5 nm (Fig. 1). The Argon Ion Laser has two peaks—one of which could be filtered out to produce monochromatic blue light (Fig. 2). In terms of photography, monochromatic means one color. A graph of the monochromatic light from the Omnichrome light source shows the energy peaks at 450 nm and is a curve extending approximately 15 nm on each side (Fig. 3). This also can be termed monochromatic blue light. Is the excitation source used in this technique monochromatic or narrow band? "Long wave ultraviolet blue light" in terms of physics could mean all wavelengths extending from the UVA (320 nm to 400 nm) to blue 450 nm. In terms of photography it could mean the light passing through a Dichroic Filter (Fig. 4). Or perhaps it could mean the use of a Woods lamp (black light) which is Long UV, 365 nm energy (Fig. 5) and an Omnichrome set at 450 nm. What does the term "long wave ultraviolet blue light" mean as referred to in the article? It would seem obvious that as the technique of using narrow bands of the electromagnetic spectrum as a excitation source and recording the emitting fluorescent light through filtered photography becomes more widespread, the necessity of standardizing the nomenclature becomes necessary. It also seems obvious that the nomenclature should be based in photography since our objective is to produce photographs.

Russell E. Schneider, DDS
4634 Grand Avenue
Gurnee, Il 60031

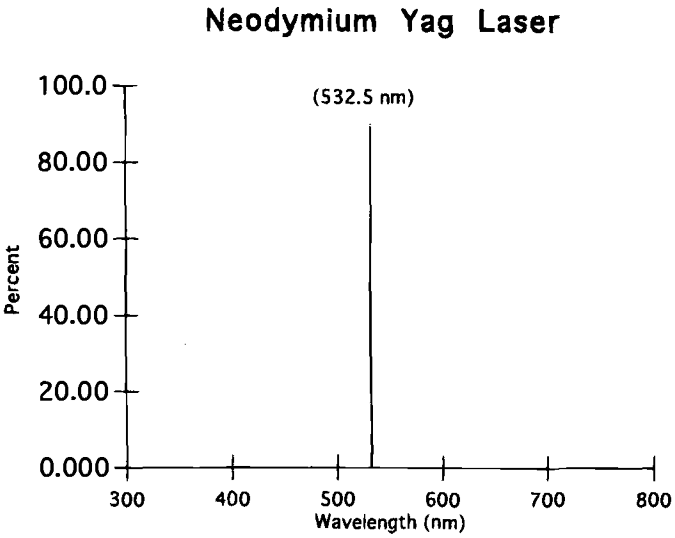

FIG. 1—*A neodymium yag laser emits monochromatic light that is 532.5 nm.*

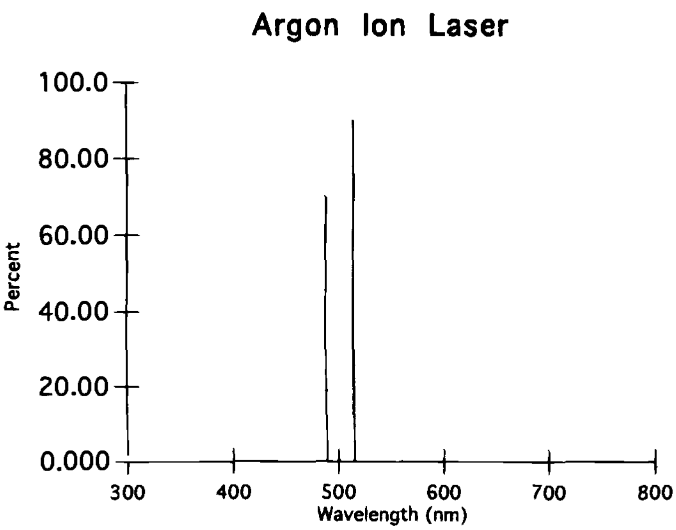

FIG. 2—*The argon ion laser has two peaks—one of which could be filtered out to produce monochromatic blue light.*

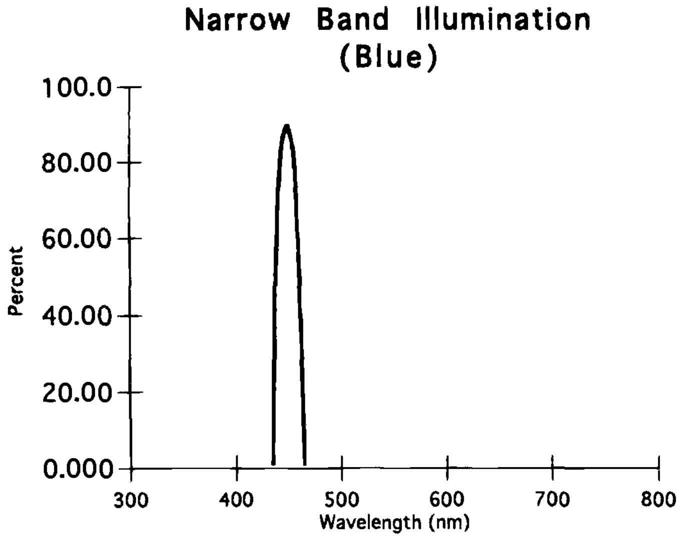

FIG. 3—*Omnichrome light source shows the energy peaks at 450 nm and is a curve extending approximately 15 nm on each side.*

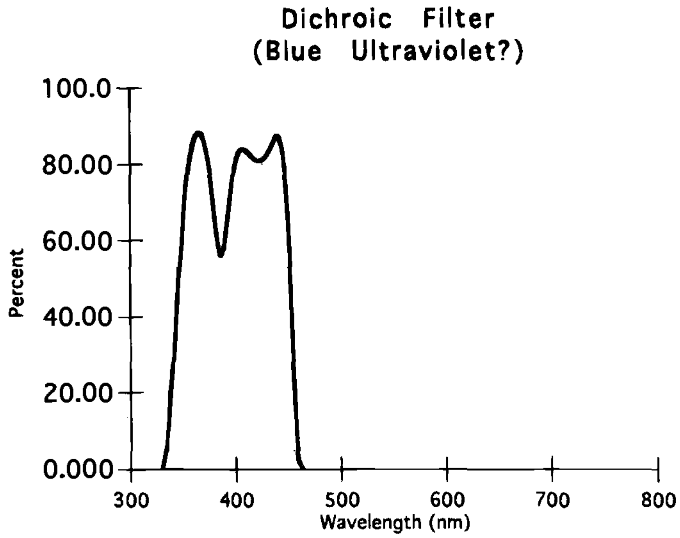

FIG. 4—*Light passing through a dichroic filter.*

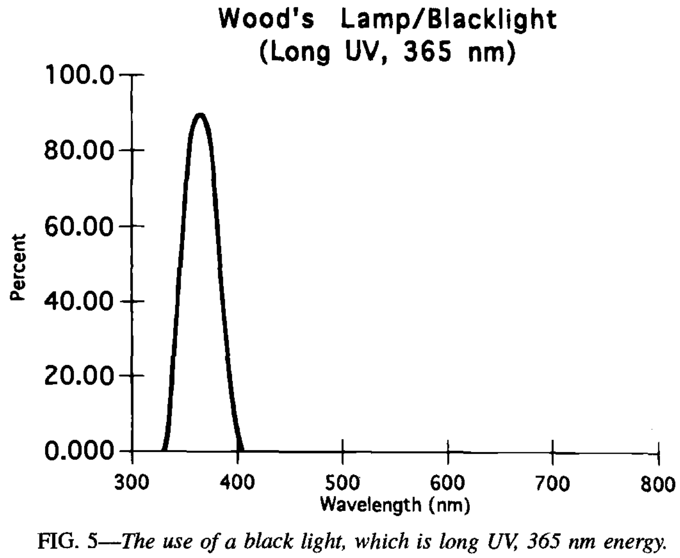

FIG. 5—*The use of a black light, which is long UV, 365 nm energy.*

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Author's Response

Sir:

Dr. Schneider has astutely pointed out a dilemma that has kept forensic investigators in a quandary since the technique of locating and photographing evidence with specific bands of the electromagnetic spectrum became popular; namely, what to call it. While there are voluminous publications addressing the subject, many of which have various descriptive nomenclatures, which Dr. Schneider has described, the common denominator in the research is *fluorescence.* I agree totally that too much confusion about the appropriate designation of this area of photography exists, and that those of us involved in its research and development as a forensic investigative tool should attempt to minimize it.

I also concur with Dr. Schneider that the nomenclature of this technique should be standardized, and that it should be based in photography, not physics. Justifiably, it is the responsibility of those individuals involved in the research and publication of scientific papers to set the standards.

In an effort to normalize communication about this branch of forensic investigation I have since begun referring to it as *fluorescent photography.* This term incorporates the basis of both conditions and can be defined as "the method of capturing an image onto a photo-sensitive emulsion using a camera, filters, and a visible wavelength other than full spectrum light."

It is recommended that researchers who document experimental results should continue to use the designation of a particular bandwidth of illumination used during a fluorescent photographic session, such as, 30 nm. The researcher/author should also indicate which filter, such as, 450 nm of the electromagnetic spectrum was used as a source for illumination. Generalizations such as "blue light, long-wave ultraviolet, and monochromatic light," are not only misleading, they are imprecise. Hopefully, through a unified effort to become consistent in terminology, this important branch of photographic investigation will become more fully understood.

Gregory S. Golden, DDS
Odontologist/County of San Bernardino, CA
77 E. Seventh Street
Upland, CA 91786

Commentary on Missliwetz J, Denk W, Wieser I. Study on the wound ballistics of fragmentation protective vests following penetration by handgun and assault rifle bullets. J Forensic Sci 1995;40(4):582–84

Sir:

The paper by Missliwetz et al. contains several misleading citations as well as apparent confusion and misconception regarding the experimental results.

Missliwetz et al. wrote about "behind body-armor blunt trauma effect," (p. 582) which "may lead to injuries of the inner organs (heart, large vessels, lungs, liver, kidneys) (see (1–3))." None of their references provides evidence of damage from "behind body-armor blunt trauma" in the human. Their first two are studies in which animals of about half the weight of adult humans were used: the effects observed cannot predict effects in the adult human. Their third citation reports a death from perforation of the chest by a 45–70 rifle bullet which hit a protective vest (which was *not* rated to stop this bullet) about two inches from the top edge of its armor panel. The bullet distorted the vest by forming a four inch long cone-shaped tube of Kevlar fabric in which the bullet remained during its penetration. This bullet penetrated the chest wall and disrupted major blood vessels; it was *not* a case of "behind body-armor blunt trauma." Approximately 700 law-enforcement officers have been shot while wearing soft body armor. The projectiles from which these officers were protected by their vests included 12 gauge shotgun slugs and .44 Magnum handgun bullets, yet none of these officers suffered more than a bruise behind where the bullet (or bullets) hit, or sometimes a split of the skin: *in no case have any of their internal organs suffered significant damage from "blunt trauma."*

Regarding the experimental results:

- The findings appear inconsistent—only 32% of the bullets that perforated vests became unstable in air, yet 11 of 12 (92%) of those that penetrated soap blocks after the vest perforation showed shorter "narrow channels" (a reflection of bullet instability). Perhaps the difficulty in measuring very small yaw angles by examining bullet holes in paper might explain this: most likely there were small increases in yaw angles (possibly one to five degrees) that went unnoticed. Although too small to perceptibly distort the bullet hole in paper, these small yaw angles would be sufficient to decrease bullet stability in soap or body tissue (which multiply greatly any small striking yaw).
- On page 584, it was explained that the "smaller wound cavity diameter" in the soap occurred because "the bullet loses velocity . . . when penetrating the vest." If the diameter of the cavity in the soap were proportional to the bullet's velocity as required in this explanation, the 5.56 mm S bullets, which produced a larger cavity after perforating the vests, *would have had to gain velocity by perforating the vest*—an obvious physical impossibility. Most likely these authors have been misled, as have others, by the fallacy that the size of the temporary cavity in soap is an accurate measure of a bullet's velocity or of its wounding potential. Off-center shots in soap blocks cause larger cavities than do the same bullets in the center of the block: there is less soap for cavitation forces to move in shots near the blocks' edges. Another factor that can mislead is variation in bullet yaw angles, which affect cavity size at least as much as velocity changes do: the smaller diameter cavities reported by Missliwetz et al. actually might have been made by bullets traveling at higher velocities, but with a smaller yaw angle, than those that made larger cavities.

Missliwetz et al. presented conclusions that appear contradictory. They wrote that "vest penetration shortens the narrow channel as compared to shots at an unprotected person . . . this is an unfavorable effect for the person wearing the vest." A paragraph later, however, they wrote "when a fpv is penetrated, the person wearing it is not necessarily worse off than an unprotected person" and "It may, however, occasionally happen that the injury effects are intensified." Others have shown, in extensive studies done on live, anesthetized, 90 kg pigs, that the damage inflicted by 5.56 mm military rifle bullets is unequivocally increased by the presence of soft body armor (1). The evidence (including that presented by Missliwetz et al.) shows clearly that the wearer of soft body armor is almost always (rather than "occasionally") likely to suffer a more severe wound if struck in the vest by a military rifle bullet than if the soft body armor were not present.

Martin L. Fackler, M.D.
Wound Ballistics Consultant
RR 4 Box 264
Hawthorne FL 32640

Reference

(1) Breteau J, Sendowski I, Martin P, et al. The personal protective equipment provided for combatants: the part played by wearing a protection vest in the behaviour of projectiles wounding outcomes. Proc 11th Int Symp on Ballistics, Brussels Congress Centre 9–11 May 1989, (Sponsored by the Royal Military Academy of Belgium) Vol III, 9–18.

Author's Response

Sir:

Doctor Fackler's letter to the Editor referring to our paper (Study on the Wound Ballistics of Fragmentation Protective Vests Following Penetration by Handgun and Assault Rifle Bullets; Missliwetz J, Denk W, Wieser I. J Forensic Sci 1995;40(4):582–584) indicates that the author of the letter has misunderstood the purpose, experimental set-up and conclusions of our paper.

The term "Behind body armour blunt trauma" was found in the literature and was cited in our paper as a theoretical possibility of injury. Criticism of this term or impeachment of its use should be addressed to the authors of the cited papers.

Indicator paper discs were used to gain a rough idea as to whether the shot becomes significantly unstable after the bullet has passed through the vest. Minimal instability with a small yaw angle is not detected by this method. The obviously incorrect conclusion that the speed of a shot accelerates after the target has been shot through was not discussed further for reasons that seemed quite clear to us. Consequently, the enlargement of the temporary wound cavity (a result of energy transfer of the shot, see page 582, c, d) can be explained only by instability, especially in view of the fact the shot did not disperse.

The authors cannot comprehend why Dr. Fackler is unable to establish a connection between the size of the temporary wound cavity and the effect of injury.

The shots in soap were located in the central region of the soap blocks.

The values obtained from measurements revealed that in persons who wear vests, the maximum circumference of the temporary wound cavity after being shot with either a 7.62 × 39 mm or .308 bullet is smaller than in unprotected persons. This indicates that the person wearing a vest is at a greater advantage. A major conclusion of this experimental study was that general statements pertaining to all vests *cannot* be made only on the basis of theoretical considerations.

Doz. Dr. J. Missliwetz
Dr. Wolfgang Denk
Institut für Gerichtliche Medizin der Universität Wien
Sensengasse 2
A-1090 Wien (Vienna) Austria