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Newtonian Physics within Crime Scene Reconstruction

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INTRODUCTION

Conceptually visualize the motion that occur within a crime scene, the forces that take place during the event. All matter is in a state of relative motion or rest, through space and time. Whether by natural force or by an external force, matter is subject to change proportionally to the force imposed. This notion summarizes Newtonian physics. Published in his 1687 text *Philosophiae Naturalis Principia Mathematica,* Sir Isaac Newton utilized these laws of motion to describe a body's natural state and that of when forces are applied. Therefore, crime scene reconstruction is not necessarily the interpretation of, but the analysis of those forces upon facts and objects within a crime scene. Within this article, Newton's laws of motion will be explained and compared to reconstructive activities during criminal investigations.

NEWTON'S FIRST LAW OF MOTION

Inertia- an object's state of motion will remain constant unless acted on by an unbalanced force.

Perhaps the most common investigative application of Newtonian physics is seen within the field of accident reconstruction. It seems that vehicles provide the best visual representation of the natural laws governing bodies in motion. To begin conceptualizing the fundamental law of inertia, consider a vehicle on a roadway. The vehicle when at rest will remain at rest because of the lack of inertia, until an outside force acts upon it. A force, such as a person pushing, will be sufficient in changing the resting state, only if such force is greater than the total static energy coefficient, i.e. weight, gravity, drag, and friction. According to Newton, the vehicle will remain in the same motion until acted upon by another unbalanced force, such as another vehicle or object in its pathway. However, we consciously recognize that the vehicle will begin to slow and eventually come to a complete stop, regardless of any barriers in the roadway. One might pose this is due to gravity, but in actuality it is kinetic friction. Gravity is a constant force regardless of position or motion, but when applied between an object and the surface upon which it is standing, the acceleration of gravity essentially continuously presses the object into the ground, and depending on the nature of the object and the ground causes different friction reactions, but all inevitably to the same conclusion: a complete cessation of movement.

Now how does this factor into criminal investigations and accident reconstruction? Anytime a criminal act, a motor vehicle accident, or even a plane or train crash occurs, investigators are called upon to reconstruct the events that unfolded that resulted in the scene that they are called to often with the only information to be derived from objects and artifacts within the scene *in situ*. When pertaining to Newton's first law and the discipline of Crime Scene Reconstruction, it is more accurate to elaborate on blunt object strikes or terminal ballistics. The static inertia of hypothetically a human skull, when changed by the impact of a blunt instrument being swung at a certain angle will change the arrangement of tissue and bone in a defined manner. This contact subsequently displaces internal fluids, such as blood, and changes the orientation of the head to a new position or trajectory. Through an examination of the angles and position of these displaced items or any blood stains, those positions or area of originating blood shed can then be approximated and potentially sequenced within an event window.

NEWTON'S SECOND LAW OF MOTION

Acceleration is produced when a force acts on a mass. The greater the mass (of the object being accelerated) the greater the amount of force needed.

When the firing pin of a firearm strikes the primer cup of a cartridge, combustion occurs and the rapid expansion of gases seek to escape the chamber. With the gas seeking a vent, the path of least resistance is the pushing of the bullet down the bore and eventually out of the barrel. This concept within internal ballistics demonstrates acceleration and is furthered when you take into account the time and length that the gases act upon the bullet; the longer the barrel and subsequent time behind the bullet, the faster the bullet will travel. This model is easily observed when comparing the velocity of a 9mm Luger bullet fired from a semi-automatic pistol, versus the longer barrel of a submachine gun.

In a concept more closely related to Crime Scene Reconstruction, blood stain pattern analysis, the reader can imagine varying volumes of free falling blood droplets. Droplets of equal volume falling from differing heights onto a perpendicular surface exhibit an increasingly larger width to a point. It is at this point where the free falling drop reaches its terminal velocity, and thus from any height above that distance will impart similar stain sizes, however varying volumes is the key consideration as well.

NEWTONS THIRD LAW OF MOTION

For every action there is an equal and opposite reaction.

Further applying Newton to the BPA aspect, if those blood droplets continue to fall within the same location, it creates a stain pattern known as a drip pattern. A drip pattern is when blood falls within blood, creating satellite stains with additional volume. With Newton, these patterns are created as the accelerating energy of a drop is distributed into the pre-deposited blood causing the preexisting blood to channel the energy out. This is begins to introduce the Third Law of Motion, with each interaction between matter equal forces act upon each of the interacting bodies, or simply stated for every action there is an equal and opposite reaction.

Consider a shooter; when he discharges the firearm the force of the projectile must be equal to the force exerted into the shooter. This is why Hollywood's depiction of grossly knocking a person back who is shot is inaccurate, as the same force would happen to the shooter. This seeming unbalanced ratio of force is the result of the difference in the high velocity of a small projectile vs. the mass of the shooter, resulting in a subjectively low recoil velocity. This principal is the observable action of kinetic energy. Because the mass of the projectile is much smaller than that of the shooter, more kinetic energy is concentrated in the projectile. Upon discharging the firearm the opposite kinetic energy is displaced throughout the mass of the shooter; this is because velocity is independent of mass. As the projectile travels in flight this kinetic energy is displaced in to molecules of the medium in which it travels, until ultimately the remaining kinetic energy is transferred into another mass. While this is one example of the third law, the concept of actions and reactions the most important principal to remember within crime scene reconstruction.

CONCLUSION

Through the understanding and application of the Newtonian principals the Reconstructionist can begin establishing the most probable flight path or origin of rest, asking the question of how an item got to the location in which it is and then determining its origin. This solid foundation of Isaac Newton's laws of motion within the realm of crime scene investigations is not restricted to only the trajectory of a bullet or a droplet of blood, but may further be applied to circumstantial evidence within a scene. The scrutiny bore upon a coffee table knocked over or broken items at the foot of a wall; inquiring what caused these objects to arrive at their current state of rest. Utilizing the scientific method to pose a valid hypothesis that questions more then was it knocked over during the course of the incident, but how the actors within the incident caused

the end result. Newton derived these principals from studying the natural world around him, for those of us within the forensic disciplines crime and violence are our natural world.

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