R. C. Menzies,[1] M.B., Ch.B., D.M.J. (Path.), Major, RAMC and L. E. Anderson,[2] B.S.

The Glaser Safety Slug and the Velex/Velet Exploding Bullet

REFERENCE: Menzies, R. C. and Anderson, L. E., "**The Glaser Safety Slug and the Velex/Velvet Exploding Bullet,**" *Journal of Forensic Sciences,* JFSCA, Vol. 25, No. 1, Jan. 1980, pp. 44-52.

ABSTRACT: The Glaser Safety Slug and the Velex/Velet Exploding Bullet are both designed to fragment on impact with their targets. Recognition of these rounds after firing is possible by the use of roentgenography and wound tract examination, and the characteristic appearances are described and illustrated. Despite the degree of physical disruption of the bullets recovery of the copper jackets will permit useful comparison microscope examination. In the case of the Velex/Velet Exploding Bullet recovery of the percussion cap may also provide useful information.

KEY WORDS: criminalistics, ballistics, wound ballistics

To those of us who spend at least part of our time surveying the effects of bullets on human beings, the concept of a "safer, more effective bullet" represents, at least superficially, an apparent contradiction in terms. For law enforcement purposes, the ideal bullet will always produce instant incapacitation—"that which will render the assailant incapable of posing a continued threat to the safety of the officer by the use of a handheld weapon" [*1*]—and this practice usually means death or very serious injury. Hence, to the target, "effectiveness" in a bullet may be said to vary inversely with "safety."

Those who design these "safer, more effective bullets" are concerned, however, with the safety of innocent bystanders who quite accidentally find themselves in the vicinity of a shooting incident involving armed criminals and law enforcement agents. Danger to these persons comes, broadly speaking, in five different ways: (1) by the intentional shooting of people by criminals in the commission of a crime because the latter wish to create a diversion or are mentally ill or intoxicated and in kidnapping or hostage situations; (2) by indiscriminate shooting by criminals as a result of panic, mental disease, or intoxication; (3) by accidental shooting by either criminals or law enforcement agents when the innocent persons

Presented in part at the 8th International Meeting of the International Association of Forensic Sciences, Wichita, Kans., 22-26 May 1978. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense. Product names used in this publication are for descriptive and identification purposes only and do not imply recommendation or endorsement by the authors or any public or private agency. Received for publication 24 April 1979; accepted for publication 8 June 1979.

[1]British Army exchange pathologist and chief, Missile Trauma Pathology Branch, Division of Forensic Pathology, Armed Forces Institute of Pathology (AFIP), Washington, D.C.

[2]Special agent and firearms instructor, Federal Bureau of Investigation Academy, Quantico, Va.

wander unwittingly into the line of fire; (4) accidentally from bullets that have struck intermediary targets and ricocheted; and (5) accidentally from bullets that have perforated their intended target and still retain enough kinetic energy to penetrate a second target directly or to ricochet.

The first three situations are largely outside the scope of the ammunition designer, although the use of "effective" bullets by the law enforcement agencies should, theoretically, abbreviate shooting incidents and thus reduce risk to innocent bystanders. The last two types of hazards, however, can be reduced considerably if the ammunition used against criminals is designed to have a low ricochet potential and a low chance of perforating a human body. The significance of the second of these characteristics is related not only to safety but also to effectiveness; as early as 1897, the British found that the metal-jacketed military bullet used against fanatical tribesmen on the Indian frontier perforated but failed to stop their targets. This led to the manufacture of the earliest expanding rounds at the British arsenal at Dumdum, India [*2*]. This observation concerning perforation is still true today; almost all police departments can quote instances where an armed suspect has received one or more perforating bullet wounds and, despite this, has been able to return fire, often with tragic effectiveness. The criteria by which ammunition for law enforcement agencies should be selected are currently the subject of great concern to many interested and disinterested parties, and the political and humane issues involved are well beyond the scope of this paper.

From a purely scientific viewpoint, the requirements of effectiveness of a bullet with a low probability of perforation and ricochet can be met by one design characteristic: rapid transfer of kinetic energy to any target encountered. This rapid transfer is achieved usually in one of two ways: (1) rapid expansion of the cross-sectional area of the bullet that increases the coefficient of drag and (2) fragmentation of the bullet on striking the target. The former represents the concept behind the various types of hollow-point bullets. In our experience, the impact velocity of these is critical if maximum expansion is to be achieved with minimum penetration of the target, and such bullets have a ricochet potential comparable to round-nosed bullets of similar design.

This report studies two types of ammunition designed to promote safety and effectiveness by fragmenting on impact. It is directed primarily at the pathologist who may be required to recognize these missiles in bodies and to recover appropriate material for ballistic matching.

Materials and Methods

The caliber selected for this study was .357, chambered for the Magnum cartridge. Specimens of each type of ammunition were examined and photographed. One Glaser Safety Slug was pulled with an inertia bullet puller; for safety reasons, this procedure was not repeated for the Velex round.

With a Smith & Wesson Model 19 revolver having a 102-mm (4-in.) barrel, several rounds of each type of ammunition were fired through photoelectric screens connected to a computing chronograph (Electronic Counters, Inc., Model 4001) into identically prepared and stored gelatin blocks (Pharmagel A, Ordnance Type 250 A, Kind and Knox Gelatin Co.; 1200 g dry gelatin powder in six litres of water) at a range of 1.5 m (5 ft). The velocities of each type of round were recorded and averaged arithmetically. Missile impact was recorded on movie film with a Hycam high-speed motion-picture camera at a speed of 8000 frames per second. Penetration depth into the blocks was also measured and treated likewise. Each of the blocks was photographed and X-rayed.

The tracts in the blocks were then cut open and as many as possible of the fragments from the missiles were recovered and photographed. These fragments were referred to the Firearms Unit, FBI Laboratories, Washington, D.C. to ascertain the possibility of matching striations satisfactorily and to determine what parts of these rounds would be of most value to the firearms examiner in an actual case.

Results

Ammunition Construction

The construction of a Glaser Safety Slug is shown in Fig. 1. The cartridge cases examined were all manufactured by Winchester-Western. The missile consists of a copper cup containing some 350 No. 12 lead shot. This is compressed and retained by the hard white plastic plug seen projecting from the intact round and to the right of the lead shot in the bottom part of the picture. The weight of the missiles was 96 grains.

Two Velex/Velet rounds are seen in Fig. 2. In profile it will be noted that the configuration resembles a regular semijacketed hollow-point bullet, but examination of the tip reveals the slightly recessed percussion cap. This is covered by a glossy red lacquer, an unfortunate choice of color from the point of view of recovery from a body or a living victim. Beneath this

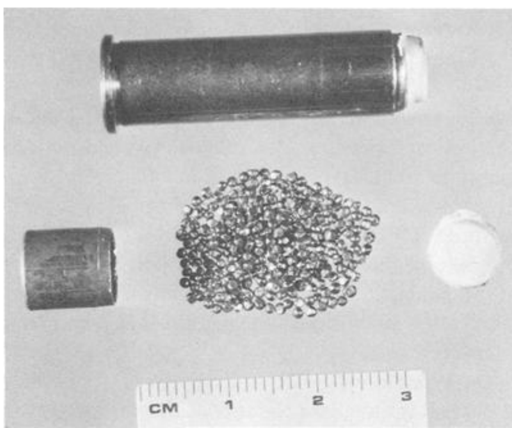

FIG. 1—*Glaser Safety Slug opened to demonstrate load. The copper cup is to the left, the plastic plug to the right, and the shot in the middle. An intact round is shown above the slug. (AFIP Neg 78-4650-1.)*

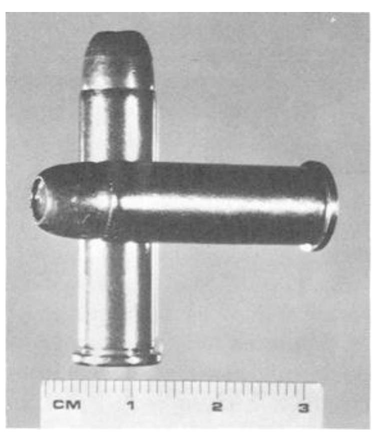

FIG. 2—*Two Velex/Velet rounds clearly showing the outline configuration and the recessed percussion cap. (AFIP Neg 78-4650-2.)*

percussion cap, the bullet is hollowed to contain about 2½ grains of black powder; in addition, one No. 4 lead shot is found at the base of this hollow in the .38 Special and .357 Magnum versions. The weight of these missiles is about 101 grains. Cartridge cases manufactured by both Winchester-Western and Remington-Peters are found with these loads.

Velocity and Penetration

The results of missile chronography and the gelatin block penetration studies are shown in Table 1. A .38 Special 158-grain lead hollow-point (LHP) is included as an example of a commonly available round designed to expand in the body, and the .44 Magnum 200-grain semijacketed hollow-point provides an example of a "much more powerful" expanding bullet; these are meant for comparison, particularly of the kinetic energy of the missile and its penetration into gelatin.

It will be seen that the kinetic energy of the Glaser and of the Velex is well above that of the commonly used .38 Special LHP. The kinetic energy for the Velex/Velet ammunition is based entirely on velocity produced by the propellant powder in the cartridge; with the facilities available, it was not possible to measure additional energy released by the explosion of the bullet itself. The figure quoted is therefore less than the total energy transferred by this type of missile to the target.

Both the Glaser and the Velex/Velet missiles showed much less depth of penetration of the gelatin blocks than either of the other types of bullets examined. When allowance is made for the fact that gelatin is, unlike even soft parts of a human body, quite uniform in consistency, it seems permissible to suggest that the .44 Magnum bullet will be likely to perforate the trunks of many people and thus result in the risk of secondary direct hits or ricochets; although less likely, it is also possible that the .38 Special bullet may behave in the same way, especially in the case of a thin victim. On the other hand, the depth of penetration of the Glaser and Velex/Velet missile is such that, except in the case of a child, perforation appears unlikely and, as will be seen later, the degree of missile fragmentation is such that any such perforating fragments are unlikely to possess sufficient kinetic energy to cause serious damage to a second target. All of these comments are based on an entry wound on the anterior trunk, with an anteroposterior tract avoiding bone. It is, of course, accepted that striking of bone will alter unpredictably the behavior of all the missiles.

Roentgenography and Tract Examination

Figure 3 is an X-ray picture of a gelatin block showing the typical appearance of a Glaser Safety Slug. The extent of "tissue" disruption is evident. The uniform size and density of the No. 12 shot is striking and contrasts notably with the irregular and less-dense copper cup. The plastic plug is not visible on X-ray.

TABLE 1—*Velocity, kinetic energy, and depth of penetration into gelatin of ammunition examined.*[a]

Caliber	Missile	Weight, g	Velocity, ft/s	Kinetic Energy, ft·lbf	Penetration, in.
.357 Magnum	Glaser	96	1839	721	4.75
.357 Magnum	Velex	101	1561	>547	4.50
.38 Special	LHP	158	913	293	8.75
.44 Magnum	SJHP	200	1338	795	13.75

[a]1 ft/s = 0.3 m/s; 1 ft·lbf = 1.3 J; 1 in. = 25.4 mm; LHP = lead hollow-point bullet; and SJHP = semijacketed hollow-point bullet.

Visual examination of the "wound" tract confirms the marked disruption of the gelatin and the widespread distribution of lead shot, fragments of the plastic plug, and the copper cap. A recovered Glaser Safety Slug is shown in Fig. 4. Unlike the common "shot shells" or "snake shot," these missiles remain intact until impact with a target. The inertia of the lead shot during deceleration ejects the plastic plug and permits dissemination of the shot in the wound. A depiction of the jacket's behavior can be seen in Fig. 5 (*b* and *c*); the jacket splits, often along the lines made by the lands and grooves of the weapon's barrel, and, as it maintains its motion from left to right in the diagram, the petals formed become folded behind the base of the cup. The finer striations are thus protected. This configuration is seen in the deformed cup shown in Fig. 4. Figure 6 is an X-ray photograph of a typical, exploded Velex/Velet missile. Mechanical disruption of the gelatin is again obvious, but the most striking feature is the extreme, irregular fragmentation of the lead bullet, in this case certainly without its encountering any hard object such as bone. The less-dense jacket is clearly visible; in this case, the percussion cap is obscured by the large fragment seen next to the jacket, but, as will be seen later, it is usually identifiable as a fragment with a density similar to that of the jacket and by its shape. The behavior of the Velex/Velet exploding bullet on impact is depicted in Fig. 5 (*a–c*). The explosion of the black powder dislodges the percussion cap, fragments the bullet, and causes the jacket to split; the split jacket then behaves in a manner similar to that described for the Glaser cup. A recovered Velex/Velet missile is

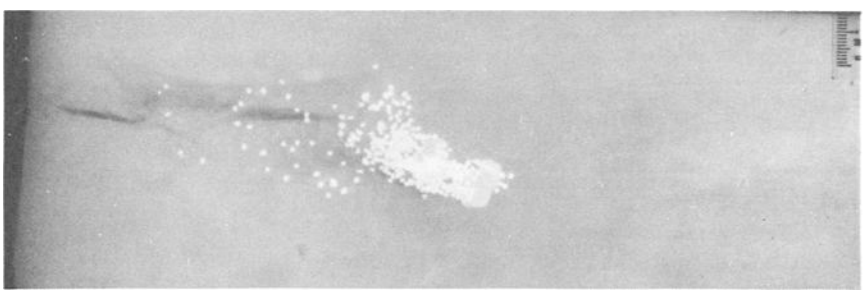

FIG. 3—*X-ray picture of a gelatin block into which a .357 Magnum Glaser Safety Slug has been fired. (AFIP Neg 78-4650-3.)*

FIG. 4—*Recovered Glaser Safety Slug showing deformity of copper cup and shot fragmentation of plastic plug. (AFIP Neg 78-4650-4.)*

shown in Fig. 7; the solitary No. 4 shot is shown between the jacket and the lead fragments; the percussion cap lies to the right of these fragments.

In our experience, Velex/Velet rounds of caliber .38 Special frequently failed to explode on impact with gelatin, and, for completeness, an expended round that failed to explode was X-rayed (Fig. 8). The missile was traveling from right to left; the object in the area between the entry point and the missile is the percussion cap. This round penetrated approximately 200 mm (8 in.).

The outstanding feature of the "wound" produced by this ammunition was black powder residue. This was copious and easily visible, and it got onto knives, forceps, and fingers to an extent that it could not be missed. A faintly sulfurous smell, characteristic of black powder, was also detectable. This residue was present even when no explosion took place; this finding, together with those of the high-speed movies of these rounds, suggested that in some circumstances the black powder simply burns in the tract.

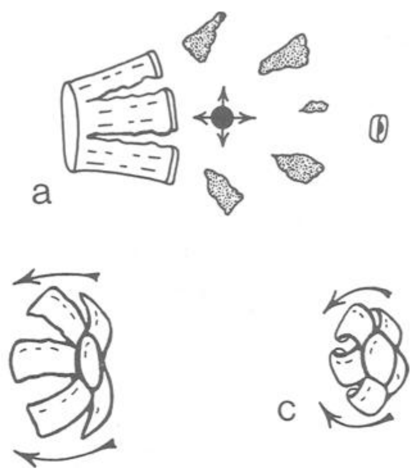

FIG. 5—*Demonstration of behavior of copper jacket and cup on impact. (See text for explanation.) (AFIP Neg 78-4650-5.)*

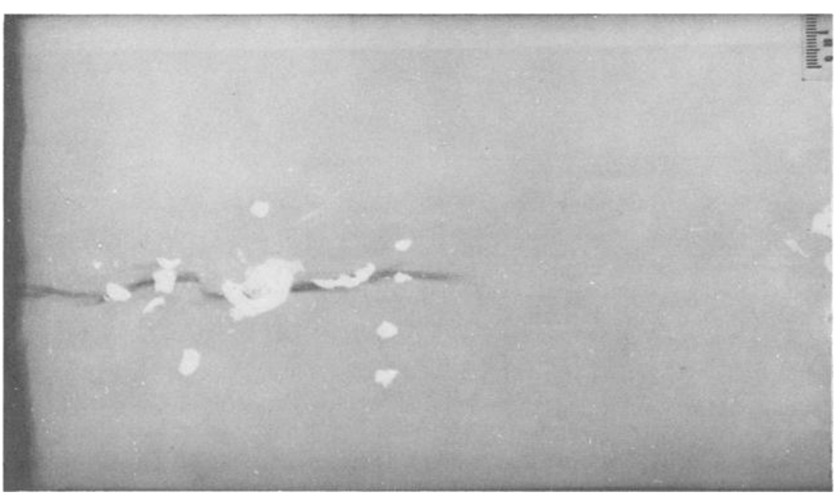

FIG. 6—*X-ray picture of a gelatin block into which a .357 Magnum Velex/Velet bullet has been fired; the bullet exploded in this example. (AFIP Neg 78-4650-6.)*

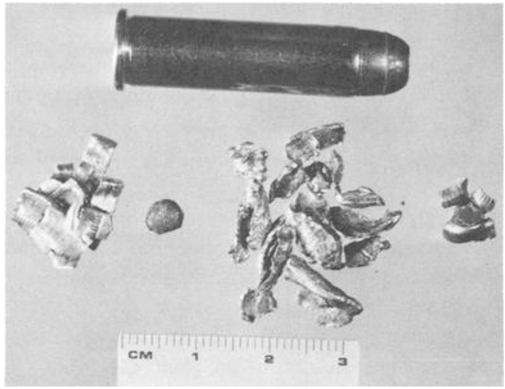

FIG. 7—*Recovered Velex/Velet exploding bullet showing (from left to right) the deformed jacket, the No. 4 shot, the fragmented bullet, and the deformed percussion cup. (AFIP Neg 78-4650-7.)*

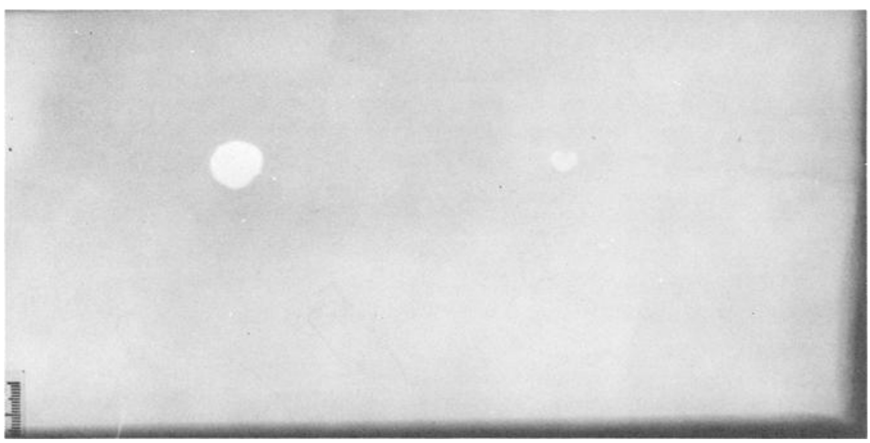

FIG. 8—*X-ray picture of a gelatin block into which a .38 Special Velex/Velet exploding bullet has been fired; the bullet failed to explode. (AFIP Neg 78-4650-8.)*

Comparison Microscopy

A description of a convincing match of the striations on part of a Glaser cup and a Velex/Velet jacket, each fired as part of this study, can be seen in Fig. 9; these missiles had been fired by the same weapon.

In addition to the cup in the case of the Glaser Safety Slug, a sample of the No. 12 shot and recovered plastic plug material would be of help to the laboratory in making a positive identification.

Although the lead fragments from the Velex/Velet exploding bullets were of no help in identification, recovery of the percussion cap and its referral to the laboratory are important. Not only does its presence confirm the nature of the ammunition, but toolmarks are present around its edges. These are the result of the machine used to insert the caps during manufacture, and they can be matched to other caps inserted by the same machine (Fig. 10). This may permit association with other ammunition found, for example, at a scene or in the possession of a suspect.

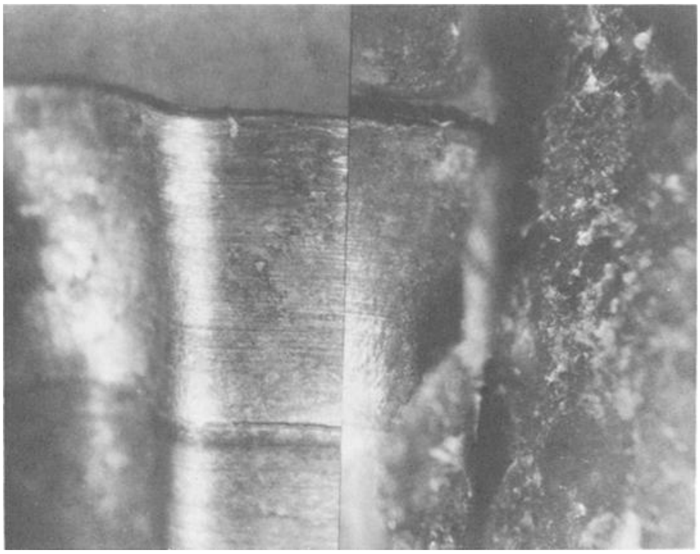

FIG. 9—*Comparison of the striations on the fragments of the jacket of a Velex exploding bullet and the copper cup of a Glaser Safety Slug is depicted. (AFIP Neg 78-4650-9.)*

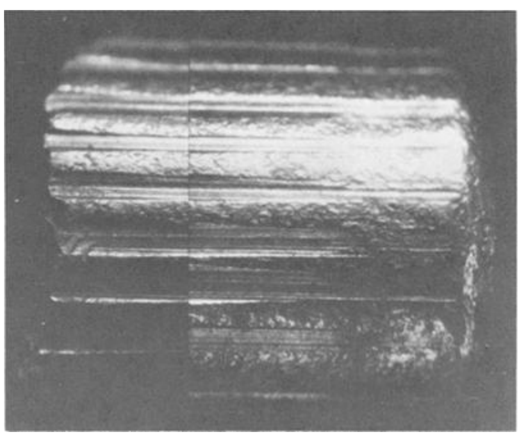

FIG. 10—*Comparison photomicrograph portraying matching toolmarks on the edges of percussion caps from two Velex/Velet exploding bullets. (AFIP Neg 78-4650-10.)*

Discussion

In the foreseeable future, the widespread regular use of either of these types of ammunition by large numbers of law enforcement agents in the United States of America seems unlikely to us. Such use, however, by individual police departments and in unusual circumstances cannot of course be entirely excluded. Despite the best efforts on the part of the manufacturers, use by criminals is probably more likely to be seen. This may occur in the situations of either "common" crime or "political" crime and, particularly in the latter case, may take place in situations of national or international terrorism including kidnapping, hostage-holding, and hijacking.

Irrespective of the situation, however, experience has shown that when shooting occurs between law enforcement agents and suspects—especially when lives are lost—accusation and counteraccusation usually follow. It is often left to the practitioners of the forensic sciences to attempt to unravel accounts of events that may be the result of accurate observation, confusion, mistake, or outright lying.

Much information can often be gained in these cases by the pathologist's interpretation of the autopsy findings and his skillful use of other forensic science disciplines. With this in mind, this paper has sought to present the salient features of these two unusual types of ammunition. It is hoped that the illustrations and descriptions will better equip pathologists to recognize patterns indicative of wounds caused by these missiles and to recover and submit adequate material for further useful study by the firearms examiner.

Acknowledgments

The assistance of the following is gratefully acknowledged by the authors: Special Agents Glenn E. Ing and Donald J. Gray, FBI, for help with the actual shooting; Photographic Division, Armed Forces Institute of Pathology, Washington, D.C., for final preparation of all the illustrations; Major George W. Irving III, USAF, VC, for taking the X-rays shown in Figs. 3, 6, and 8; Leesy McDonnell, medical illustrator, Scientific Illustration Division, Armed Forces Institute of Pathology, Washington, D.C., for preparation of Fig. 5; Firearms Unit, FBI Laboratories, Washington, D.C., for advice on the importance of recovery of missile parts and the original photographs of Figs. 9 and 10; Captain Robert L. Thompson, MC, USN, chairman, Department of Forensic Sciences, Armed Forces Institute of Pathology, Washington, D.C., for assistance with editorial and publishing matters after the departure from the AFIP of one of the authors (R. C. M.).

References

[*1*] Dobbyn, R. C., Bruchey, W. J., and Shubin, L. D., "An Evaluation of Police Handgun Ammunitions," Summary Report LESP-RPT-0101.01, U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., 1975.

[*2*] Owen, I. K., "What About Dumdum?" *FBI Law Enforcement Bulletin,* April 1975.

Address requests for reprints or additional information to
Armed Forces Institute of Pathology
Washington, D.C. 20306