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STARSHIPS IN *CHAMPIONS*

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What's Behind the Combat System

Twilight: 2000 Design Notes

Frank Chadwick

Ever since we at GDW published *Twilight: 2000* we've been receiving a lot of comments on the game, particularly the combat system. For some reason, the combat system excites a great deal of passion, and people seem to love or hate it. Unfortunately, there was not a great deal of space in the game for designer's notes, and so there is no explanation of how I arrived at the system as it currently stands. When *Space Gamer* asked if I'd like to write an article on the subject, it seemed like the perfect opportunity.

Basics

When I began work on the combat system, there were a number of important criteria which ultimately shaped the system. First, the system had to be mechanically simple. I wanted there to be as little calculation, as few actual steps, and as few special cases and rules as possible. Second, I wanted the combat system to be as universal as possible; radically different systems for dealing with attacks on vehicles and people would make for awkward weapons descriptions for those weapons useful against both. Likewise, different systems for different types of personal combat cause problems with integrating damage results. (If you are beaten half to death, burned half to death, and shot half to death, are you dead or just half dead or what?) Third, I wanted the system to reflect the relatively high effectiveness of modern small arms. Fourth (and in seeming contradiction to the third point), I wanted the combat system to be survivable. I felt this was particularly important to an extended roleplaying game dealing with an essentially violent environment.

Hit Probability

This is an area that I honestly thought I would take a great deal of static over, but I was pleasantly surprised. In the game it is extremely difficult to hit someone, even close up. In fact, at ranges where it is child's play to hit a man-sized target on a rifle range it is still an iffy proposition to score an actual hit. My reason for departing from firing range accuracy is that firefights have never generated anywhere near the number of hits you would expect by extrapolating from firing range statistics. In fact, I suspect that the hit probabilities are, if anything, generous. Even firefights at extremely close range, like several feet, often generate surprisingly few casualties, and a unit will routinely expend *thousands* of rounds of small arms ammunition for each hit it inflicts. In the game it takes a much lower volume of fire to begin producing casualties.

Once I had a hit probability system I was comfortable with for small arms, I had to integrate anti-vehicle weapons, and do so with as little fuss as possible. Hit probability statistics are available for most large caliber guns, but they refer to the chances of hitting a vehicle-sized target, and immediately the spectre of target size modifiers reared its ugly head.

Fortunately, I fought back the temptation to take the easy way out (easy for me, the designer, but a pain in the backside for players). Instead, what I ended up with was the rangefinder bonus in the game. By adding this in, I managed to separate rangefinding from weapon ballistics, which was necessary anyway. By making the rangefinder bonus apply only to vehicle-sized targets and larger, I managed to get the effects of a target size modifier where it counted, without having to fuss with it all the way through the rules. All in all, a happy solution.

Armor Penetration

Since both personal armor and armored vehicles would be present in the game, I realized from the start that the question of armor penetration would have to be addressed directly and fairly forcefully. I knew that with as many tank freaks out there as there are, having categories like "light, medium, heavy, very heavy" for armor just wouldn't cut it. I also wanted an armor and penetration system that was easy for the gamer to understand, not only from a mechanical point of view but also in terms of its rationale. As a result, I adopted a scale based on millimeters of steel, which makes for a system fairly open to examination; my armor and penetration values are not hidden under piles of obtuse calculations.

Although I won't profess to expert status on large caliber ballistics and penetration, it is at least something that I've been working with on my other designs for the last couple years, and so it isn't real intimidating. Small arms penetration, however, was virgin ground. Fortunately, Marc Miller here at GDW is something of a small arms expert in his own right, and was of considerable assistance throughout the project. The actual decisions, however, were mine, and thus any inaccuracies in the system are my responsibility, not his.

The resulting system is very straightforward and open to examination. The design decision to simplify firing by dealing with four distinct range bands imposed some compromises, but I don't feel that they are serious distortions of reality. In retrospect (and it is always easier to see these things when looking back), the one area of the penetration mechanics that bothers me is the sharp fall-off of energy at extreme ranges. No one has written in complaining about this, and I suspect that (as in the "real world") very few firefights are conducted at extreme range. However, for those of you who have ammo to burn, retaining long range damage/penetration at extreme range produces a closer fit to reality, and I recommend it.

Wound Profile

The thorniest problem I had to deal with in the combat system was the actual effect of a gunshot wound on the target. After as much time and thought as I put into the system, I have to admit to reacting very negatively to people who critique it by presenting their own view of reality as if it were proven and demonstrable fact and then sneering because the game system doesn't match that view. If the game research led me to any conclusion, it is that we really still do not have a sufficiently sound grasp of wound physics to predict the exact result of any particular gunshot wound, and any pretense to the contrary is usually based primarily on ignorance rather than knowledge.

In October of 1984, during the final design phase of the game, I had the opportunity to attend the two-day Small Arms Symposium at the J.F.K. Special Warfare Center at Fort Bragg. Although my schedule was pretty tight, I made time for it — and later was very glad that I did. Among the twenty-plus presentations at the symposium was one by Dr. Martin Fackler entitled "Method for Predicting

Wound Profile," which summarized all of the latest findings of the Wound Ballistic Laboratory at Letterman Army Institute of Research (of which Dr. Fackler is the director). Some readers out there will perhaps remember an old Firesign Theatre album entitled *Everything You Know Is Wrong*. That might have made an equally appropriate title for Fackler's presentation.

Most of what we know about wound ballistics has been based on actual battle casualties and suppositions as to how the wound occurred. The Wound Ballistic Laboratory has instead been concentrating on analysis of controlled live firings into very large gelatin blocks (of the same consistency as muscle tissue), supplemented by limited controlled fires into anesthetized lab animals. The gelatin blocks enable high speed photography to actually record the behavior of a round in a resisting medium and measure hydrostatic shock effects. I had a chance to talk with Dr. Fackler later, and I could probably go on for pages about this, but will limit myself to a few interesting findings.

Bullet Tumble: The popular notion of bullet tumble is that small, high velocity bullets (due to their instability) tumble through the body, while larger bullets tend not to, and that the tumble is constant throughout the passage of the bullet through the target. Wrong. *All* bullets are stable, *all* bullets tumble, and *all* bullet tumble consists of a single 180-degree change in orientation after entering the wound. The bullet then continues in its trajectory, but rear-end first. As a considerable amount of the tissue damage occurs as a result of the tumble, the *length* of the bullet is one of the most important elements in determining its wounding potential.

Wound Cavitation: Most high velocity combat rounds create a permanent wound cavity the diameter of the bullet and a much larger temporary cavity, which varies with the kinetic energy of the round. This large temporary

Reviewing A Review:

Frank Chadwick Responds to Greg Porter

I know, I know. Every time a designer gets an unfavorable review he screams "foul!" and then bitches and moans about how tough life is. I'm not real crazy about reading that sort of thing myself, but Greg Porter's comments do, it seems to me, at least require some response. In his review in *Space Gamer* 74 he describes ***Twilight: 2000***'s combat system as "abysmal" and supports this with what purports to be a representative example of play. In this example, a soldier wearing a ballistic helmet and Kevlar vest is hit in the head and chest by 23mm HE cannon rounds and not injured, succeeds in "ventilating" several tanks and APCs with his G-11 submachine gun, and is then finally disabled, but not killed, when hit by a 75mm HE round.

Well, one thing at a time. In the game it is true that 23mm HE cannon rounds hitting a character in the chest wearing a Kevlar vest will just knock him down, and that strains reality a bit, doesn't it? Even given a 10-year advance in the state of the art in personal protection, a 23mm HE round is going to do some damage, even if it doesn't penetrate the vest, through concussion and momentum ("blunt trauma," to get technical). What would be required here would be an additional damage system for blunt trauma that would cover broken bones and internal injury. I decided, however, that an additional damage routine was not justified for just one case. Yes, *one* case. Of the twenty-plus large caliber rounds in the game, the 23mm HE round is the only one which cannot penetrate a Kevlar vest. A 23mm API round (just as cheap and common as the HE round) will go through Kevlar like butter, as will any heavy machine gun.

Furthermore, if the 23mm HE round hits the head, half the rounds will hit the unprotected head (instead of the ballistic helmet) and blow the guy's head off. Any hits in the arms or legs will immediately incapacitate the fellow. Any non-penetrating hits to the vest or helmet make the guy vulnerable to fragmentation to his unprotected body parts. Given all this potential for lethal collateral damage from the hit, I didn't feel that the extra damage procedure was necessary. And it should be clear from this that Greg's example is about as far from representative as you can get.

Next, ventilation of tanks and APCs with the G-11. The G-11 in the game fires a special high velocity armor-piercing round designed to defeat light armor, and that it can do so should not be a real big surprise. However, the ammunition is extremely rare, so rare that players cannot even start the game with any and have to be fairly lucky to find any. (There's only a 40% chance that a character will find any in a major city, of which there are two left in all of Poland.) The G-11 is hardly a typical weapon, either in performance or availability. By the way, its classification as a submachine gun is due to its high rate of fire and very easy handling characteristics, which enable it to be fired with the same ease as a submachine gun. Technically it is an assault rifle, but characterizing it as such would make it less effective than it is. Greg should be careful not to read too much into its name.

One important point that Greg glosses over in his example is what happens when his typical soldier "ventilates" the APCs and tanks. Nothing happens in the example, because nothing much happens in the game. The G-11 round may go through the side of an APC or the overhead armor on the engine grate of a tank, but will not have enough remaining energy to damage any internal components. It may cause a light wound to an occupant, but I don't find that out of line considering the type of ammunition I am projecting for it. Considering that Afghan Mujahadeen are putting Mauser rounds at close range through the sides of BTR-60s and killing the drivers, I suspect that this may be generous to the APC occupants, rather than vice versa.

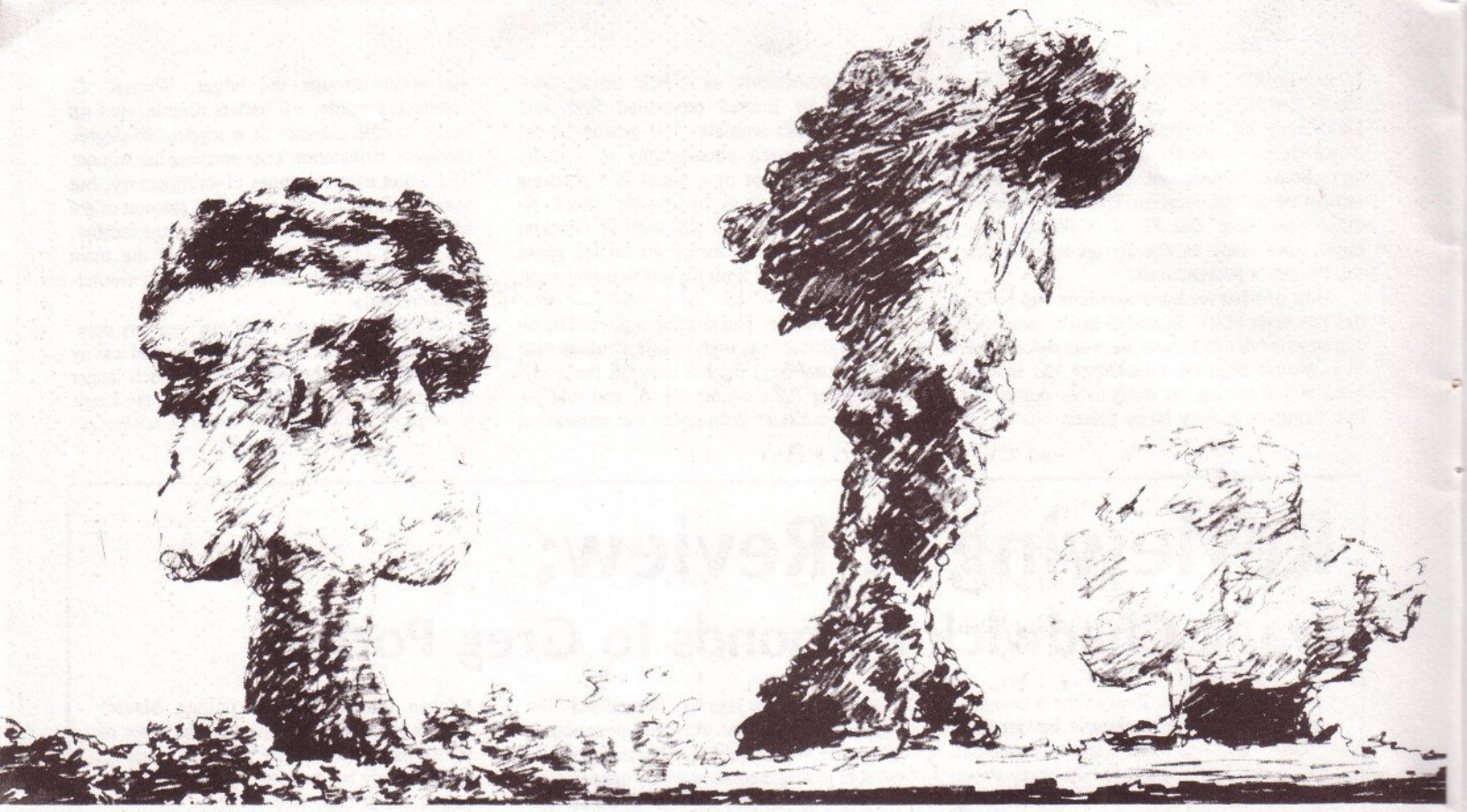
Finally, in Greg's example the player is hit by a 75mm round and "It doesn't quite kill him, but it will suffice." How it doesn't quite kill him is a mystery to me. The average character has a hit capacity of 30 in the chest. Four times this, or 120, will kill him. The average 75mm HE round will do 280 hits, which will kill anyone, Kevlar vest or not.

The combat system in ***Twilight: 2000*** isn't perfect, and I think Greg's review pointed out one anomaly that it produced. I still feel it is an unimportant one, both because of its extreme rarity and because in the example given the player would probably get done in by factors Greg chose to ignore (like fragmentation of hits). It is always dangerous, it seems to me, to say that a system is poorly thought out because of one anomaly.

I don't want to trivialize the anomaly. My penetration data for HE rounds was based on very large rounds. While the blast is the main component there, smaller HE rounds have a higher proportion of their damage caused by the actual kinetic energy of the projectile, and therein lies the rub. I should not have been so hasty in applying a universal HE armor modifier to all weapons based upon what works for a 155mm howitzer. If I may, therefore, I would like to propose a "repair kit." Change the following armor multipliers:

23mm HE: from x10 to x5
25mm HE: from x10 to x6
30mm HE: from x10 to x7
40mm HE: from x10 to x8

—Frank Chadwick



cavity is visually shocking, but closes up relatively quickly (tens of minutes) and appears to cause no serious cellular trauma to muscle tissue. Its effects are much like a severe bruise. The permanent cavity appears to be the extent of serious trauma, and it is determined by the diameter of the bullet (and its length at the point of tumble).

Hydrostatic Shock: Almost all of our assumptions about hydrostatic shock appear to have been mistaken, and it does not now appear to be significant in producing damage. While there is a clear and measurable hydrostatic overpressure wave caused by bullet impact, it passes through tissue too quickly to damage the cells. The single exception to this is when hydrostatic overpressure is applied to a rigidly contained system. (This is why a sealed tin can blows up when you shoot it on the pistol range.) However, the human body, including the circulatory system, is sufficiently elastic to absorb the hydrostatic shock of any known bullet. The one exception is the head; the skull is sufficiently rigid and a comprehensive enough containment vessel to make hydrostatic shock a severe danger from head wounds.

All actual supposed examples of hydrostatic shock wounds (usually characterized by gaping exit wounds) in fact appear to be due to multiple exit wounds. In fact, even European researchers who are advocates of the hydrostatic shock theory have been unable to duplicate the effects in a laboratory with anesthetized animals on a consistent basis; all experiments which produced the symptoms of hydrostatic shock were accompanied by bullet disintegration, and thus multiple exit wounds. (I suppose I should add here that jacketed combat rounds do not normally disintegrate in the body.)

What Does It All Mean?

In listening to Dr. Fackler's presentation and in my brief talk with him later, I was impressed that the man who is perhaps the most knowledgeable researcher in wound ballistics in the country made no pretense of predicting the medical effects of a gunshot wound. We are just beginning to understand the effects of a gunshot wound on muscle tissue; its effects on the skeletal system and a variety of internal organs are areas that have yet to be subjected to any significant controlled study.

The wound modelling system I proposed is admittedly a fairly abstract and simplified one, but one which is based on a fair amount of research and some thought. I have no illusions as to its "accuracy"; our knowledge of wound ballistics is so limited that we do not have the ability to produce a completely "accurate" computer-driven model, let alone one suitable for a roleplaying game. But a system of some sort is necessary, and several principles guided me.

First, I noticed that several times as many people survive gunshot wounds as die of them. Therefore, it seemed obvious that a gunshot wound is not necessarily fatal.

Second, in the heat of combat people often suffer fairly serious injuries and continue to function normally. This is due in part to shock and in part to the fact that people in mortal danger are usually higher than a kite on adrenaline, noradrenaline, testosterone, and all sorts of other interesting glandular secretions. (This, by the way, has something to do with the remarkably poor marksmanship displayed in combat as well.)

Third, the effects of a gunshot wound can in many respects be modelled by random damage and random death, given how little we know about actual internal wound physics. However, this is very unsatisfying from a game point of view. Therefore, it seemed best to have some sort of linear damage system, with incremental damage based on a variety of ballistic characteristics of the bullet.

Fourth, if a simple system (which I felt was required) has to err, it is better to err in favor of survival than in favor of lethality; this makes for a better game.

Based on this, I developed the wound modelling system for ***Twilight: 2000*** and where error was mandated by the simplicity of the system, I deliberately erred in favor of survival. Given our lack of reliable knowledge in this area, I feel that discussion of this issue would be most constructive if it centered around game utility and overall feel. As I said above, criticism which seems based on the attitude that "I know what's *really* happening here and you missed it with this system" leaves me cold.

There is one aspect of the wound model that I freely admit is completely inaccurate; it is impossible to kill a man with a single rifle shot to the chest. You can knock him down, you can seriously injure him and knock him unconscious, and he may die of an infection later, but you cannot kill him with a single shot through the heart. From a game point of view, I don't consider this a major problem, but I can understand players who might. If you like, consider using the following rule:

"Any time that a character receives a gunshot wound to the chest which penetrates his body armor and inflicts at least one actual hit point, roll D10. On a roll of 1 the character is dead." □