Chit Chat April 8, 2014

A BANG FOR A BUCK, OR LESS

There are a few things that characterize all human societies. . Whether the individuals are headhunters in New Guinea, or Nobel laureates, they all eat, sleep, excrete and procreate. Beside all that, they all find ways to kill one another in various and ingenious ways; and they have always done so.

Tonight I am going to talk about this phenomenon. It will not be a philosophic discussion or one of values. It will be of the most significant discovery that mankind has ever made which has permitted him to do that killing easier, cheaper and more efficient. I arrived at this subject initially in analyzing the wounds men have inflicted on each other and how they have changed over the years. To quote Professor William Hodgkinson in the *Encyclopedia Britannica 11th Ed., 1911:*

"Very few substances have had a greater effect on civilization than gun powder. Its employment altered the whole art of war, and its influence gradually and indirectly permeated and affected the whole fabric of society. …."

Not only is gunpowder plentiful, just as importantly, it is cheap. Its most important ingredient was originally simply a product of horse

manure and urine. And it is gunpowder or a derivative that is the prime ingredient of most bombs and bullets. Not a day goes by when depressingly, the news does not have a story of people shot or a bomb detonated somewhere in the world. Since its invention gunshots and bomb detonations have caused and continue to cause countless deaths and injuries. Aside from millions of wartime casualties over the years, for example, some 2000 children are killed or injured by gunshot each year in the US alone, where guns outnumber people. It is gunpowder and its history is what I want to talk about tonight.

It was the Chinese in the Han Dynasty who first described saltpeter. Saltpeter is the primary ingredient of gunpowder. Some unknown alchemist apparently appreciated the crystals that formed in horse stables could be combined with common sulfur and charcoal in a simple mixture to make an inflammable mixture with immense explosive properties. We know these crystals to be potassium nitrate, known from the Middle Ages as *saltpeter.* By the 9th C the Chinese used gunpowder for ceremonial purposes and festivals primarily for noisemaking and fireworks. They also used gunpowder for primitive rocket weaponry. Europeans first encountered

gunpowder weapons at the Battle of Mohi used by the Mongol Invaders in Hungary 1241. The formula for gunpowder made its way westward through the Middle East. Saltpeter naturally found in deposits in India, was known as *Chinese Snow* by the Arabs. Initially it was rare and extremely expensive. That saltpeter could be produced remained a secret until the late Middle Ages. This rarity naturally retarded and restricted its use. Once the secret of production was out by the 14th C, the immense demand led to entire farms in Central Europe to be converted into virtual plantations devoted exclusively to the production of saltpeter. Cheap gunpowder then became the catalyst for the development of a whole new class of weapons that changed the character life in Europe and ultimately everywhere else.

For the invention of the first weapon to use gunpowder outside of Asia, we can blame the unlikely Bernie Schwartz, a name little known today. Berhold Schwartz was German monk who reputedly invented the first firearm in Freiburg in the 13th C. He took advantage of the writings of Roger Bacon, the English monk who was the first European to record a formula for gunpowder in his *Letter of Secret Works in Art and Nature* (Trans), 1267. Several recipes gunpowder

appeared thereafter in the *Liber ignium,* an Arabo-Spanish compilation around 1275. Nitrate proportions varied depending on usage, bore size and gun length. The use of gunpowder as a propellant was natural follow-up to well-established weapons already in common use for centuries. The Romans refined the ballista or catapult as a siege weapon. The newer infantry weapon, the crossbow was common in the late middle ages. The word *gun* was first used to mean a firearm in 1339 and is derived from the Anglo-Latin word *gunnum,* simply meaning a siege weapon. Somewhat later the French word cannon came into use perhaps to distinguish the gunpowder weapon from other forms. The first use of cannon was recorded in the Saracen siege of Boza, 1325. But canon must have been used earlier as the manufacture of cannon along with brass and iron balls was authorized by the Council of Twelve of Florence in order to defend the Florentine Republic at about the same time. Edward III's invasion of Scotland 1327 employed cannon and both sides used cannon in France at the battle of Crecy in 1346. Aside from rendering defensive walls around cities and fortress obsolete, the initial use of firearms was limited to the degree it caused panic in the ranks of the enemy. It was only later with the further development of lighter and more flexible firearms were such weapons

truly effective in pitched battle as when the Spanish under the famous Gran Capitan, Gonzalo De Cordoba defeated the French in Italy at the battle of Cerignola in 1503. This battle put the finishing touches to the medieval knighthood and chivalry. The matchlock musket and field canon used here effectively for the first time proved the futility of body armor.

In order to batter down the walls of cities and fortresses here-to-fore thought to be impregnable, cannons were cast in progressively larger diameters and longer length to take advantage of ever more plentiful cheaper gunpowder. For example, the price of gunpowder in 1450 was only 20% of what it had been a century earlier. The effects were dramatic. For example the successful siege of Cherbourg by Henry V in 1418 took 7 months. By 1450 the walls of Bayeux gave way in only 5 days solely the result of the use of cannon. Similarly, 2 years later, the massive fortress of Constantinople fell to the cannons of the Ottoman Turks, ending a thousand years of Byzantine civilization

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Early guns were giant in size, valuable and jealously guarded. Each required as many as twenty men to manage and were moved with great difficulty. They were often cherished and given personal names. One can see *Mons Meg* today at Edinburgh Castle. Cast in

Burgundy in Mons, Belgium and sold to the Scots, it has a bore diameter 19.5 inches and weighs 5 tons. It threw a shot of 549 pounds. An even larger gun in Vienna: *Pumhart von Steyer*, has bore 31.4 inches and shot a 583 lb. stone. These giant guns shot balls most often of stone. Stone was a holdover from the ancient catapults, and was the most economical of all missiles. These too can be seen today in Europe. They remain as decoration and traffic barriers as in The Hague around the Royal Palace. Only later were smaller caliber missiles made from lead or cast Iron. Canon metallurgy unfortunately did not keep up with other developments and the premature ignition of powder combined with cannon breech explosions accounted for the very high casualty rate amongst early gunners. Limitations of strength of brass and cast iron used in muzzle loading cannons restricted their size and their reliability. The breakthrough came in the mid 19th C. with high test steel breech loading cannon first produced and sold world-wide by the Krupp Company of Essen, which made the name Krupp steel famous and the family one of the wealthiest in Germany.

Besides being a propellant, gunpowder was also used for other purposes. Explosive cannon balls made their appearance in the 1600's. It was gunpowder used for blasting that made major

construction projects such as canals and railroad right of ways possible in the 19th C. Blasting for military purposes started early. The Mongols used hand thrown bombs in the 1200's.

Besieging armies in the renaissance often resorted to mines to broach stout defenses; a technique which continued through the First World War. Igniting a large quantity of gunpowder underground placed in strategically placed tunnels was enough to destroy whatever was over it. Perhaps as often as it succeeded however, a mine failed in its ultimate purpose. A prime example was the slaughter of Federal troops who were trapped in the crater formed by the mine explosion in a tunnel built by recruited Pennsylvania coal miners. It was set off beneath the Confederate works in the siege of Petersburg, in the Civil War. The mining of the Messines Ridge, Belgium during the Ypres offensive in 1917 produced the largest planned blast in history that is until the Atomic bomb. It noise could be heard across the Channel as far as London. Three mines containing 13,000 pounds of explosives killed some 10,000 German soldiers. However, the end of the war was not significantly hastened. Every British child learns: *"Remember, remember the 5th of November; gunpowder, treason and plot*!", Guy Fawkes Day. Fawkes and his fellow dissident Catholic plotters put back the cause

of English religious reconciliation one hundred years in 1605. Because of loss of secrecy, they failed in their plan to blow up Parliament using a stash of gunpowder secretly hidden beneath the chamber. The plotters caught and tortured, paid with their lives.

Besides antipersonnel mines used against troops, the undersea mining of strategic waterways started in the 18th C. and continued with enthusiasm through the 20th C. A good example was the mining of the Dardanelles by the Turks in World War I that led to the failure of the Gallipoli Campaign. Buried mines set by the thousands in Viet Nam and left over from the war are still maiming and killing innocent civilians long after the fighting has stopped. Bomblets, dropped by the thousands by the Americans remain unexploded and persist as inadvertent antipersonnel mines.

In wartime deliberate and inadvertent detonation of gunpowder and other explosives is common and will not be particularly discussed, but the effects particularly in encounters at sea can be dramatic. A single artillery shell or bomb hitting a powder magazine can destroy a ship and an entire crew in seconds with a fortuitous hit as when *HMS Hood* went down in its encounter with *Bismarck* in 1943. An entire British army surrendered when a lucky French cannon shot detonated its entire ammunition store in Spain in the Napoleonic Wars.

Accidental gunpowder explosion, always a danger using artillery, has had frequent disastrous consequences. Recall that the Athenian Parthenon preserved intact since classic times became a classic ruin, the result of detonated gunpowder stored there in 1687. Boulevard St. Germaine des Pres, Paris is named for a former monastery dating from the 7th C. It was destroyed along with irreplaceable medieval artifacts by exploding gunpowder stored there during the French Revolution. The famous hospital in Paris, the Salpetrière, was built in the 17C. on the original site of a medieval royal gunpowder factory. Louis XIV had discontinued it for safety purposes. The town of Halifax, Nova Scotia was leveled by an explosion of an ammunition ship that started burning following a ship collision in its harbor in December 1917. Two square miles of Halifax were flattened and 2000 people died. A canon from the ship was found 2 miles away where it remains there today as a monument. Parts of the ship were thrown 1000 feet in the air. That accidental explosion was the greatest in history until the Trinity A-Bomb test in 1945. However there are many other examples of significant but lessor accidental gunpowder explosions throughout history. Accidental gunpowder magazine explosions in early San Francisco, led to the establishment of the magazine and powder factory in the town of Hercules, in the

East Bay actually named for the company that manufactured the powder. The American Navy experienced its first mass mutiny of mostly black sailors after 320 lives were lost in our own Port Chicago naval ammunition ship disaster in 1944. 4000 tons of explosives detonated without warning while being loaded for the Pacific war.

Gunpowder ignites in a way that is still not completely understood. The mixture of potassium nitrate in the presence of sulfur and carbon is highly volatile and if packed correctly will burn so rapidly that with rapid expansion of the formed gases, an explosion will occur even without the presence of atmospheric oxygen. Nitrogen is the most common gas in our atmosphere and in general, Nitrogenous compounds are typically unstable and stored energy absorbed in their creation is relatively easily released. Think of protein compounds metabolized to release stored energy to support most living organisms.

Common nitrogenous waste present in the urine breaks down to ammonia and then converted by bacterial action to active nitrite and then to nitrate. Animal feces is a rich source of potassium. This in the presence calcium or magnesium in the form of seashell or lime to encourage bacterial growth, combined with the nitrate released from

the urine results in the formation of crystals of potassium nitrate or saltpeter. Deposits of saltpeter are found around the world particularly where bird, animal or bat excreta have accumulated over time. For example, bat droppings were harvested in Kentucky's Mammoth Cave to make gunpowder during the War of 1812. The nitrates in the guano collected off the coast of Chile from centuries of bird droppings were the major source of saltpeter source for years. Guano now used mostly for fertilizer. However, converting fertilizer into bombs is relatively simple. Steven McVeigh destroyed of the courthouse in Oklahoma City utilizing such a bomb.

The explosive potential of gunpowder such as black powder of the late middle ages consisting of 75% potassium nitrate, 10% sulfur, and 15% carbon is quite remarkable. One gram can produce heat to 2,700 degrees C. and over 3½ liters of gas. In a closed system it is a bomb and as part of an unanchored tube it is a rocket, and propelling a projectile from a tube, it is a gun. Gunpowder burns rapidly and progressively but not instantaneously. Small changes in its formulation and configuration of powder granules can have a profound effect on its speed of burning and its resulting useful action. Rapid powder conflagration is required for small arms fire while slower burning is most useful for artillery, mines or rockets.

Regulating the speed of burning was effected most commonly by controlling the size of the powder grains. Powder burns inwardly from the surface of the granule, thus he larger the granule the slower it is consumed. In practice the slower the combustion, the less strain is exerted in the gun permitting a larger bore. As handguns were developed in the renaissance, finer grain more rapid combusting powders were necessary. This produced a dilemma on the part of the powderers. The smaller the granules of powder the more surface area is exposed per volume and the more easily water could degrade the mixture. Keeping one's powder dry was a very meaningful expression; wet gunpowder is useless. To prevent such degradation, often the raw materials for gunpowder were actually combined in the field by experienced powderers. Creating a uniform mixture of saltpeter, sulfur and charcoal, making a paste drying it and then crumbling the cake into desired granule size was the technique called *corning.* This led to standardization and more effective powder. In the renaissance powderers were highly skilled and highly paid.

Black powder was the common propellant and explosive through most of the 19th C. With large armies now in the field battles were obscured by smoke from small arms as well as artillery to a point

where commanders were often in a quandary as to the exact location of their own troops not to mention those of the enemy. Wind direction understandably was often critical in aiming weapons as well as in deploying them. Battle fields in the Napoleonic Wars, the Crimea and our Civil War when large batteries of artillery were deployed on both sides, were severely obscured by gunpowder smoke. When American troops faced the Spanish defenders in Cuba in 1898, they were confronted with the newer smokeless powder for the first time. The Spaniards fired smokeless powder cartridges from German-made Mauser rifles. Where the Americans could no longer spot the enemy by the tell-tail puffs of smoke, they were being picked off as they themselves were revealed using conventional black powder. Understandably, then the use of smokeless powder became universal.

Delivering explosives by means of larger and still larger cannons progressed to a point where Paris was bombarded by distant Prussian siege guns in 1870 and again in the First World War by a giant German cannon*, Big Bertha*, some 30 miles away. Also aerial bombardment became a reality then, with bomb carrying Zeppelins and aircraft. Working on the theory that more and bigger bombs and

explosives could be decisive in wartime, later first swarms of German aircraft and then later Allied in massive numbers decimated British and then German and Japanese cities. In World War II, horrendous civilian casualties were experienced on both sides. Initially aerial bombing was highly inaccurate. On any given night before radar, British bombers failed to bomb the primary target 30% of the time. By the end of the war German factories in spite of the intensive bombing were still producing as many tanks as they were at the beginning. That tactical bombing did not succeed in its purpose was discovered first by the Germans in the Battle of Britain in 1940. Targets were then shifted. Massive indiscriminate strategic bombing of civilian centers resulted in the destruction of cites such as London, Coventry, Berlin, Hamburg, Dresden and Tokyo. In 1942, 1000 British bomber nighttime raids were being carried out. Giant 2000 pound block buster bombs were a record at the time. Although the payoff was potentially huge, bomb delivery was always vey dangerous. In the Second World War, the life expectancy of a bomber crew was only 15 missions. At sea delivering explosives by torpedoes though submarines was highly effective in sinking Allied shipping in both World Wars. Similarly virtually all Japanese shipping was eliminated in WW II through our own submarine action. Paradoxically, the attacking

submarines were occasionally destroyed by the very explosions from the ships they had torpedoed. Ultimately the war in the Atlantic was won by other explosives in the form of depth charges and air attack. The war in Europe was ultimately won with the use conventional explosives on the ground with various firearms and artillery. The war against Japan on the other hand was decided by the two unconventional explosives: Atomic Bombs dropped on Hiroshima and Nagasaki. Until the Hydrogen bomb tests these were the biggest planned explosions in history. Controversial in their use, the rapid capitulation that resulted is estimated to have saved one million American and unnumbered Japanese lives. The delivery of explosives to the intended targets is frequently solved in self-destructive ways that are difficult to prevent, witness the successful Kamikaze suicide attacks in WW II and suicide vests worn by modern Moslem fanatics in the Middle East.

Although there have been no further world wars there have been plenty of lessor wars where bombing and detonations were and are common place both by organized and unorganized combatants. Perhaps this is because explosives are so simple to manufacture. Gunpowder was a favorite in what has become a long list of explosives that depend on the unstable nature of nitrogen

compounds. TNT or tri-nitro toluene was developed by a German chemist originally as a yellow dye in 1863. It proved to be a powerful safely handled explosive which remains a standard today for military and industrial use. Nitroglycerine was formulated in 1843 but was so unstable that its use was limited until Alfred Nobel discovered a means to render it safer. Prior to this, in 1866 the Wells Fargo office in San Francisco was destroyed by an accidental nitroglycerine explosion that killed 15 people. It had been stored for planned use to blast the 1600 foot Sierra Crest Tunnel for the construction of the transcontinental railroad. Nobel made a fortune that is the basis of the Nobel Prize awards established by his will in 1895. He simply stabilized nitroglycerine with diatomaceous earth. He patented this as Dynamite in 1867. It has over twice the explosive force as does TNT or gunpowder. It is the basis of modern smokeless powder and the explosive, cordite. We can thank the use of dynamite for the Panama Canal and for most of the other major excavation and construction projects both here and abroad in the 19th and 20th C.

In the United States there are more guns than people and gunfire and killing is almost a daily occurrence. Although there is no longer a world war, the world continues to be bedeviled by continuous daily reports of bombing and shootings by informal armies, terrorist groups

or simply by individuals. Since the 19th C. nihilists and anarchists and other bomb throwers and shooters have caused havoc and destruction for various political and non-political reasons. To mention just two of several European assassinations: Czar Alexander II of Russia was killed by such a bomb in 1881, abruptly cutting off planned political reforms which could have averted the future Russian Revolution. A couple of pistol shots ended the life of the heir to the Austrian monarchy in 1914, thereby precipitating the First World War. The United States has not been spared. Besides four of our presidents being shot down and killed, one was seriously wounded and four others were safe after being shot at. There have other major American assassinations by firearms: Bobby Kennedy, Martin Luther King and Malcolm X, to mention just three.

We have not been spared bombs. The Los Angeles Times building was deliberately bombed in 1910 during a steel workers strike which killed 20 people. A horse and 38 innocent people were blown to bits in 1920 when a dynamite laden wagon was detonated at noon on Wall Street. Scars in the granite façade of the J.P.Morgan building remain today. The destruction of the Oklahoma City Federal Office Building has been mentioned. The more recent deliberate explosive destruction by the Taliban of the massive ancient 200-foot Bamian

Buddhas carved in solid rock in 6th C. Afghanistan was an irreparable loss to civilization. The terrorist bombing in the Madrid and London subways and the latest bomb detonation here at the Boston Marathon last year all resulted in panics senseless maiming and death.

The author of the Encyclopedia article 100 years ago was not wrong. The effects of gunpowder have permeated and affected the whole fabric of society.

The sad catalogue of the misuse of gunpowder and its relatives in shootings and bombings is long and unfortunately is likely to get longer. Its cheapness and availability facilitates that all too human characteristic to harm and kill one another. Until that characteristic is addressed by society, I believe attempts at controlling the effects of gunpowder are not going to be successful. One can only hope that that while the gunpowder genie cannot be put back in the bottle, its bang might at least become fainter. As a humanist and optimist I believe in such human progress and against the odds I remain hopeful.

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