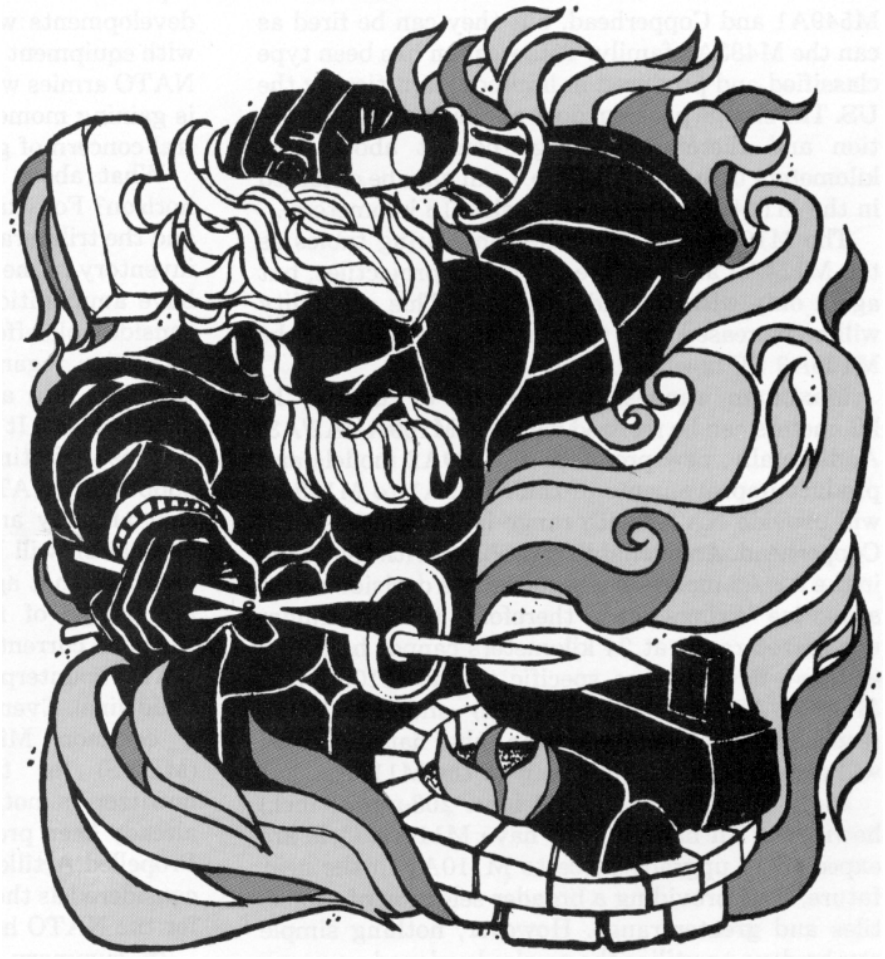
Greek Fire

The Best Kept Secret of the Ancient World

by 1LT Richard Groller

It has been said that military secrets are the most fleeting of them all; yet, there was one which was so well kept that it was lost to antiquity. This is the secret of the composition of "Greek fire," the wonder weapon of the ancient world. Still somewhat of a mystery today numerous theories have been proposed to explain the enigma and the one advanced here seems to me to be the most plausible.

The first known use of Greek fire is recorded in Byzantine chronicles as having occurred at the end of the 7th century A.D. Theophanes (811-815 A.D.) in his Chronography tells of this event during the seven-year seige of Constantinople. There, emperor Konstantinos IV (Pogonatos) who reigned from 668-685 A.D. led the Roman forces against the Arabs led by Yazid, son of the Khalif of Syria. According to his account (and according to legends) an architect named Kallinikos (who undoubtedly was also a chemist) invented "Greek fire" and instructed the Romans on how to use it to do battle against the superior fleet of the Arabians. The battle which took place, circa 671 A.D., found the small Roman fleet greatly outnumbered by the forces of the Khalif. The Romans, however, now had a new wonder weapon to use and equipped their ships with "siphones" (tubes through which the liquid fire was projected) before going into battle. The results were devastating, as Greek fire enveloped not only the Arab fleet but also the surrounding water. The Arabs found



Hephaestus, Greek God of fire.

Greek fire to be inextinguishable, except by sand or vinegar or an amount of sand treated with vinegar, and as a result their fleet was destroyed.

Konstantinos VII (Porphyrogennitos) says that Kallinikos, who fled from the town of Heliopolis to the Romans, invented the art of projecting liquid fire through siphons but seemed to imply that he was not the inventor but one who found a better way of using it in war.[1] He attributed the origin of Greek fire to Constantine the Great, saying

[1]Partington, James R., A History of Greek Fire and Gunpowder (M.B.E., D.Sc.) copyright 1960 by W. Heffer and Sons, Ltd., Cambridge England, page 14.

that its secret had been given him by an angel and that "those imparting it (the secret) were anathema and one about to communicate it had been struck by lightning."[2] Because of the angelic nature of Greek fire, the earliest chemists called their science "the divine art."[3] The name "siphon" was used for "the double-action force-pump or fire engine invented by Ktesibios and improved by Heron. In Hesychois, the word "siphon" means a water-pump for extinguishing incendiaries (also means a bent tube for transferring liquids and a pipe through which water is forced like a fountain)."[4]

No doubt, on ships, the "pump" was connected to a metal pipe from which the Greek fire was projected by some flexible tube through which liquid was poured from earthenware pots. On land, a small hand siphon was created to project Greek fire and has been described by a Spanish Muslim physician in his book on surgery (1013 A.D.) as a cylindrical syringe with a piston. The siphon used aboard ship, however, was made of wood with an internal casting of bronze. It was mounted on a false floor above the deck of the ship and could be aimed left, right, or upward so that the liquid fire could be either thrown on enemy ships or in the faces of attacking troops. The *Byzantine Cheland,* a light vessel with a crew of 120 to 160, was fitted with tubes for the launching of Greek fire. "Each of the Byzantine galleys was fitted in the prow with a tube ending with the head of a lion or other beast (often a dragon) made of brass or iron, and gilded, frightful to behold, through the open mouth of which fire could be projected by the soldiers through a flexible apparatus."[5]

Greek fire was used to repel the invasion of Constantinople by Igor the Russian in 941 A.D. In this battle, a Russian flotilla of several thousand ships was defeated by 15 semifracta chelandria (chelands) which threw liquid fire on all sides, from the prow, the stern, etc. and the Russians, rather than burn, threw themselves into the water; those weighed down by armor were drowned, and those who were able to swim died a fiery death. Greek fire was also used in the seige of Durazzo in 1108, when the Normans under Bohemond had mined the walls, and the Byzantines had countermined, igniting it when they reached the sap. As Anna Komnena, the daughter of Emperor Alexios I Komnenos, described: "A battle between the Greeks and Pisans near the island of Rhodes in 1103 . . . the enemy ship was rammed in the stern and the fire pumped over it. The Pisans fled, having no previous experience of this device and wondering that fire, usually which burns upwards, could be so directed downward or towards either side according to the will of the engineer who discharges it."[6] In Anna Komnena's time, Greek fire was considered a state secret. The Emperor, who lent troops and liquid fire to his allies, reserved for himself its secret and sent it to them ready-made. Anna gives the composition of the incendiary material as follows: "This fire they made by the following arts. From the pine and certain evergreen trees, inflammable resin is collected. This is rubbed with sulphur and put into tubes of reed, and is blown by men using it with violent and continuous breath. Then in this manner it meets the fire on the tip and catches light and falls like a firey whirlwind on the faces of the enemy."[7]

In the meantime, the Saracens, who had been so surprised and horribly beaten because of the Greek wonder weapon during their seige of Constantinople, had become thoroughly familiar with Greek fire and used it against the Crusaders in Syria and Egypt. The Greek fire was used by special "naphtha troops" attached to each corps of archers in the Muslim army, who wore fireproof suits and threw the incendiary material. Army engineers had charge of catapults, mangonels and battering-rams. One engineer, Ibn-Sabir Al-Manjaniqi, left an unfinished book on the art of warfare showing that the Arabs were very well acquainted with petroleum.

In seige war, the method of attack consisted of filling up the ditch or moat surrounding a fortress with stones thrown by ballistae and then rolling forard a high wooden tower, close to the walls. At the top of the tower was a hinged drawbridge, which was lowered on to the rampart and across this stormed the Crusaders, concealed in the tower, ready to do hand-to-hand combat. This method was used by the Normans under Robert Guiscard in attacking the Byzantine army under Palaeologos at Dyrrachium in 1082 A.D.

> "The Norman tower, built from the wood of ships which had been put out of action by the Venetians, had inside a broad staircase and 500 troops in complete armour. During the building of the tower, the besieged had built on the ramparts a slender framework of masts and yards which excited

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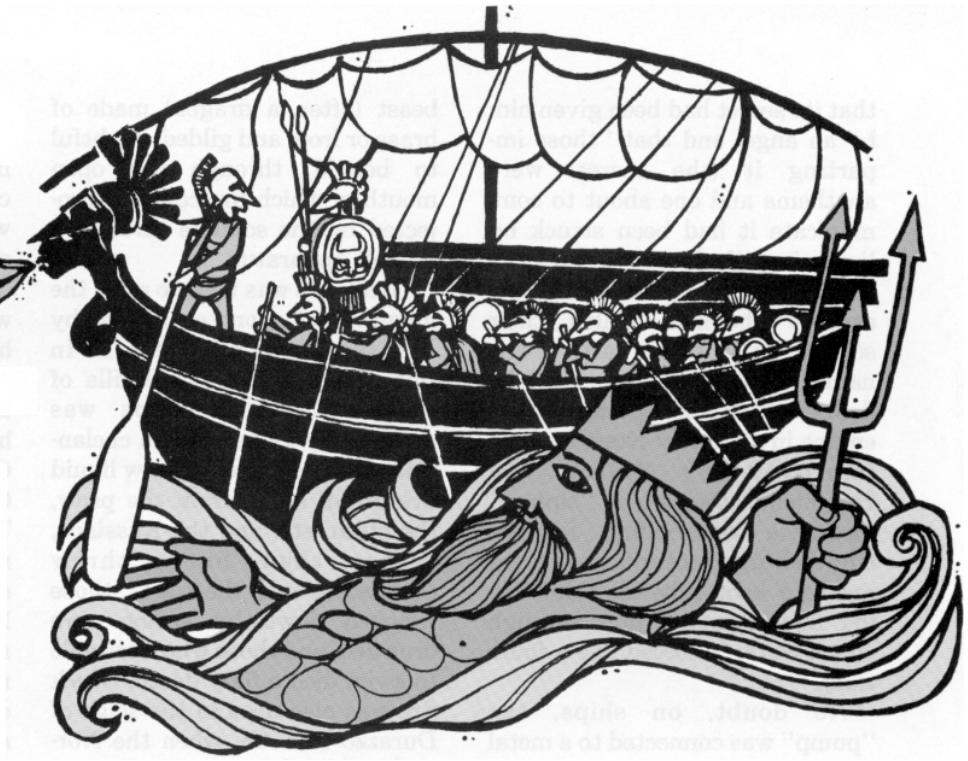
[2]Ibid., page 21.
[3]Ibid., page 14.
[4]Ibid., pages 15-16.
[5]Ibid., page 19
[6]Ibid.
[7]Ibid.

the contempt of the Normans. The immense tower was pushed forward on an inclined plane and wooden tramway up to the wall. The framework on the wall descended and wedged the drawbridge firmly against the structure, closing the tower as by a door. At the same instant an immense quantity of incendiary material was poured and projected from the walls over the wooden tower, which was quickly enveloped in flames and smoke. As the tower, with its contents, collapsed, a sortie was made and the work of destruction completed."[8]

The famous seige of Acre in the Third Crusade (1190-91) is described by Ibn Al-Alathu as follows:

"The man from Damascus in order to deceive the Christians, first threw pots with naphtha and other things, not kindled, against one of the towers which produced no effect. The Christians, full of confidence, climbed triumphantly to the highest stage of the tower. The man from Damascus, waiting until the contents of the pots had soaked into the tower, at the right moment threw on to it a well burning pot. At once fire broke out over the whole of the tower and it was destroyed. The fire was so quick that the Christians had no time to climb down and they and their weapons were consumed. The other two towers were similarly destroyed."[9]



Greek fire was used during the Third Crusade against the Venetians at Constantinople, during the Fifth Cruasade during the seige of Damietta (1208), and against the French forces of King Louis IX (Saint Louis) during the siege of Mansure in the Nile Delta in 1249. Greek fire was also used, along with gunpowder and cannon, in the siege of Constantinople in 1453, when the Turks used a heavy gun (over three feet caliber) throwing stone balls weighing 600 pounds. A Turkish siege tower, according to Phrantzes and Doukas, protected by a triple covering of buffalo hides, was burnt down by Greek fire during the siege, but Constantinople fell and so did the Byzantine Empire.

The exact composition of Greek fire remains unknown to this day. Before its first use in the seventh century, other incendiary materials were used in warfare and often have been confused with or taken for Greek fire. Among these are:

•Liquid petroleum or naphtha, from oil wells in Iraq (Hit) or Kerkut (across the Tigris, in ancient Assyria), probably used together with burning pitch and sulphur by the ancient Assyrians. In Greek and later times the petroleum wells in Armemis and the shores of the Caspian Sea were also available.

•Liquid pitch, used by the Greeks from about 430 B.C. in fire-cauldrons, fire-ships, etc., and on incendiary arrows.

•Mixtures of pitch, resin, and sulphur, used by the Greeks from 424 B.C.

•A mixture of quicklime and sulphur, inflaming on contact with water (186 B.C.)

•A mixture of quicklime and sulphur with other inflammable materials such as bitumen, resin, naphtha, etc., inflaming on contact with water, mentioned in an interpolation (sixth century A.D.) in the *Kestoi* of Julius Agricanus.

J. R. Partington's central thesis concerning Greek fire (in

[8]Ibid., page 24.
[9]Ibid., pages 24-25.

his book *A History of Greek Fire and Gunpowder* is that the main ingredient was distilled petroleum since Greek fire is always described as a liquid or semiliquid. The liquid fire was also called incendiary oil. "Romocki had realized that petrol would be a very effective incendiary if projected by pumps and, since Julius Africanus had spoken of 'natural petroleum,' there must have been an artificial (distilled) kind, but he thought it was probably mixed with solid materials. The recipe given by Anna Comnena shows that the solids were pine resin and sulphur, but the essential ingredient, petrol, she deliberately omits."[10] Quicklime would not be a suitable material and is never mentioned as a component of Greek fire. Petrol, obtained by distillation, could be projected burning, or sprayed and then lighted by an incendiary arrow. It would float, still burning, on water. Both the effective range of projection and the stability of the flame would be increased by thickening the liquid, "even but not necessarily to the extent of producing a paste by dissolving in it resins or solid combustibles."[11]

In short, all the properties and effects of Greek fire and all fire and all descriptions of the methods of making and using it, agree with Partington's thesis: "Distillation is described by the Spanish-Arabic physician Abu'-1-Qasim (Abulcasis)(A.D. 1013 and 1107), and it could easily have been adapted to making petrol. Before this, knowledge of distillation had passed from Egypt to Syria and might have been known there to Kallinikos; it was already known in Constantinople. It seems probable that the process was used in Constantinople to make the essential constituent of the new invention."[12]

It is very probable then, that the basis of the earliest Greek fire was liquid rectified petroleum or volatile petrol. Petrol itself would not be very effective in flame-projectors since the projected jet dissipates too rapidly. But thickened almost to a jelly by dissolving in it resinous substances and/or sulphur the particular admixture, coupled with the mechanical means of projecting it, together constituted a great achievement of chemical engineering.

Oman, in an attempt to piece together the motley of the Byzantine writers, concluded that Greek fire was a "semiliquid substance, composed of sulphur, pitch, dissolved nitre (saltpeter) and petroleum boiled together and mixed with certain less important and more obscure substances."[13] If the saltpeter is omitted, this is not a bad description of Greek fire.

Conclusion

History, then, may regard the mystery of Greek fire from a variety of viewpoints. The general historian may view it as an invention affecting the very existence of nations or groups of nations. The historian of science may view it purely as a trivia of antiquity, an invention with little import today except as a footnote. The historian of technology may view it in the light of its application and the devices invented to help it produce a needed effect. Finally, the military historian may view it an explosive and propellant, an artillery weapon used for defense and offense which, through careful security and effective protection from enemy intelligence, faded into the mists of time and remains the subject of conjecture and wonder today.

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[10] Ibid., pages 29-30.
[11] Ibid., page 30.
[12] Ibid., page 31.
[13] Ibid., page 32.

Reunions

144th Infantry Regiment (originally the 4th Texas Volunteer Guard — Annual reunion on 26-28 June 1981 in Dallas, TX. For more information, contact C. A. Austin (Secretary), 108 SE Tarrant, Burleson, TX 76028.

Texas 36th Infantry Division (T Patchers) — Fifty-sixth annual reunion and convention on 3-6 September 1981 in San Antonio, TX. All former members welcome. For more information, contact Leonard E. Wilkerson, 11121 Visalia Drive, Dallas, TX 75228. Please enclose a stamped self-addressed envelope.

255th Field Artillery Battalion — World War II members reunion on 5-6 September 1981 in Evansville, IN. Contact Marvin M. George, 44 N. Jackson Avenue, Apartment E2, San Jose, CA 95116.

Headquarters and Headquarters Battery, 8th Infantry Division Artillery — World War II veterans will meet 25-27 September 1981 at the Holiday Inn (downtown), P.O. Box 1856, 6th Avenue and Ocean Boulevard, Myrtle Beach, SC 29577. For information, contact james C. Woolley, 1011 Cliff Place, Baltimore, MD 21226.