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NAVAL FIRE/LIQUID FIRE. BYZANTINE „MIRACLE” WEAPON AND THE QUESTION OF ITS FAMILIARITY TO THE BULGARIANS BETWEEN THE 7th AND 11th CENTURY

Voluminous *literature*¹ has been composed on the subject of Greek fire². Despite numerous attempts to analyze it deeply enough and describe in full detail, the weapon has remained mysterious in certain aspects, and especially in such as the precise chemical composition of the incendiary mixture used by the Byzantines (which was the Greek fire proper) as well as the details of the equipment used for discharging it. This ignorance of ours clearly proves that the Byzantines managed to keep the secret from their friends and enemies equally effectively.

The purpose of this article is to present the most important scholarly theories on the subject of Greek fire that have been developed and popularised so far and to take a position

on a thesis promoted by G. N. Nikolov, an eminent Bulgarian historian, who maintained that the skill of producing the weapon and using it with deadly efficiency against their foes was mastered by the Bulgarians at the beginning of the second decade of the 9th century, namely in the year 812 (and in the wake of their capture of the city of Mesembria)³.

Origins of Greek fire

The invention of Greek fire is commonly ascribed to a certain Kallinikos, an architect from Helioupolis in Syria. Theophanes the Confessor reports on this event: *At that time Kallinikos, an architect from Hellioupolis in Syria, took refuge with the Romans and manufactured a naval fire with which he kindled the ships of the Arabs and burnt them with their crews. In this way the Romans came back in victory and acquired the naval fire*⁴. The development is said to have taken place at the beginning of the 670's, when the Byzantines had to struggle for survival in their mortal combat against the constantly growing power of the Arab Caliphate⁵. The mention proves that the chronicler regarded the invention of the new weapon as a technological and military breakthrough of the utmost importance because it greatly contributed to checking the Arab expansion into the Byzantine territory. It should be admitted, of course, that the utilization of various incendiary substances⁶ and

¹ The subject of naval fire has been discussed by (amongst others): C. Zenghelis, *Le feu grégeois et les armes à feu des Byzantins*, „Byzantion”, Vol. 7, 1932, pp. 265-286; N.D. Cheronis, *Chemical Warfare in the Middle Ages: Kallinikos' Prepared Fire*, „Journal of Chemical Education” 14.8, 1937, pp. 360-365; J.R. Partington, *A History of Greek Fire and Gunpowder*, intr. by B.S. Hall, Baltimore 1999, passim; H.R. Ellis-Davidson, *The Secret Weapon of Byzantium*, „Byzantinische Zeitschrift”, Vol. 66, 1973, pp. 61-74; M. Mercier, *Le Feu Grégeois*, Paris 1952; J. Haldon, M. Byrne, *A Possible Solution to the Problem of Greek Fire*, „Byzantinische Zeitschrift”, Vol. 70, 1977, pp. 91-99; T. Korres, „Hygron pyr”. *Eno hoplo tes Byzantines nautikes taktikes*, Thessalonike 1989; A. Roland, *Secrecy, Technology, and War: Greek Fire and the Defense of Byzantium*, „Technology and Culture”, Vol. 33, 1992, pp. 655-679; J. Haldon, „Greek fire” revisited: recent and current research, [in:] *Byzantine Style, Religion and Civilization: In Honour of Sir Steven Runciman*, ed. E. Jeffreys, Cambridge 2006, pp. 290-325; J.H. Pryor, E.M. Jeffreys, *The Age of the ΔΡΟΜΩΝ: The Byzantine Navy ca. 500–1204*, Leiden 2006, esp. pp. 607-631; G. N. Nikolov, *Bulgarzy i ogień grecki (VII-XI w.)*, [in:] *Byzantina Europea. Księga jubileuszowa ofiarowana profesorowi Waldemarowi Ceranowi*, eds. M. Kokoszko, M.J. Leszka, Łódź 2007, pp. 449-455; idem, *Greek fire and the Bulgarians in the Early Middle Ages*, „Bulgaria Mediaevalis”, Vol. 1, 2010, pp. 51-58.

² In the present study we use the term Greek fire, though we are fully aware of the fact that during the period we discuss it was not employed by those who made use of the weapon. Between the time of its invention and the beginning of the 11th century, the subject of our research was called in a number of fashions, for instance ὑγρόν πῦρ (liquid fire), πῦρ ῥωμαϊκόν (Roman fire), πῦρ θαλάσσιον (sea or naval fire), πῦρ σκευαστόν (processed fire), πολεμικόν πῦρ (war fire). On the subject of the pertaining nomenclature cf. T. Korres, „Hygron pyr”, pp. 55-59; J.H. Pryor, E.M. Jeffreys, *The Age of the ΔΡΟΜΩΝ*, pp. 608-609.

³ On the military developments in Mesembria cf. below.

⁴ Theophanes, *Chronographia* AM 6165, rec. C. de Boor, Vol. 1, Lipsiae 1883, hereinafter: Theophanes (English transl. – *The Chronicle of Theophanes Confessor. Byzantine and Near Eastern history AD 284–813*, transl. introd., comm. C. Mango, R. Scott, assist. G. Greatrex, Oxford 1997, p. 494).

⁵ On the conflicts between the Byzantines and the Arabs during the period cf. amongst others: E. Eickhoff, *Seekrieg und Seepolitik zwischen Islam und Abenland. Das Mittelmeer unter byzantinischer und arabischer Hegemonie (650-1040)*, Berlin 1966, pp. 20ff; A.N. Stratos, *Byzantium in the Seventh Century*, Vol. IV (668-685), Amsterdam 1978, pp. 15-53; J.H. Pryor, E.M. Jeffreys, *The Age of the ΔΡΟΜΩΝ...*, pp. 25ff; W.E. Kaegi, *Confronting Islam: Emperors versus Caliphs (641–c.850)*, [in:] *The Cambridge History of The Byzantine Empire*, ed. J. Shepard, Cambridge 2008, pp. 369-381.

⁶ Thucydides, for example, writes about sulphur and pitch as typical incendiary substances used in the 5th century BC against constructions with wooden elements. They were employed, for instance, by the Lacedaemonians against the defenders of Plataea

devices⁷ in warfare was not the idea of the sole Byzantines. However, it ought to be added that it was they who were the first to take advantage of such weaponry on a larger scale and more efficiently. Although Theophanes's fairly laconic mention does not let us conclude whether Kallinikos either worked out the composition of the incendiary substance itself or contributed to developing an efficient way of firing it at their enemies or, ultimately, achieved both, it could be inferred from the words of the chronicler that Kallinikos' merits in this respect were significant enough to perpetuate the tradition that the creation of naval fire should be associated with his name.

Composition of Greek fire

We have already written that Byzantine attempts to keep the composition of naval fire secret were so successful that all today's historians can only surmise what it was. In the history of the research into the issue three main standpoints concerning the composition of the substance can be distinguished.

a. Saltpetre theory – Followers of the first hypothesis are inclined to promote the thesis that the basic ingredient of Greek fire was saltpetre⁸ and consequently regarded the mysterious deadly substance as an ancestor of gunpowder. This conclusion was drawn from descriptions which referred to a loud, thunder-like audible effect of using the weapon, accompanied additionally by clouds of thick smoke, and also on the fact that the flame of Greek fire could be projected from a siphon at a distance⁹. This view, however, has two main shortcomings. First of all, we have no evidence whatsoever that saltpetre had appeared in Europe and the Near East by the 13th century. Neither was it mentioned in Arab sources¹⁰. What is more, the physical properties of the final product received from it (which by the way are commonly known because they were well described) are dramatically different from those that we know about from extant Byzantine and other sources¹¹.

– *Thucydides historiae*, II, 77, 3, 5-4, 1, Vol. I-II, eds. H.S. Jones, J.E. Powell, Oxford 1942 (hereinafter: *Thucydides, Historiae*). The knowledge of such materials was fairly common and long-lasting since pitch is mentioned as an incendiary substance even by non-military and rather antiquarian works like *Liber Suda – Suidae lexicon*, θωρυκίων, θ, 444, 1-6, rec. A. Adler, vol. I-IV, Lipsiae 1928-1935.

⁷ Thucydides (*Historiae*, II, 75, 5, 1-6, 1) mentions flaming arrows as a type of an incendiary weapon to be used in similar occasions, while fresh animal hides were utilized in order to protect timber structures from destruction. Other examples as for Antiquity cf. J.R. Partington, *op. cit.*, pp. 1-3. Other instances of employment of analogous substances and equipment in the early Byzantine period cf. Th. Korres, „Hygron pyr”..., p. 21.

⁸ B.S. Hall, *Introduction*, [in:] J.R. Partington, *op. cit.*, p. XXV-XXVI.

⁹ A. Roland, *op. cit.*, p. 659.

¹⁰ J.R. Partington, *op. cit.*, pp. 21-22.

¹¹ R.J. Forbes, *Naphtha goes to War*, [in:] *More studies in early petroleum history, 1860-1880*, Leiden 1959, p. 83-84.

b. Quicklime theory – The supporters of the second theory, which has evolved out of the observation that Greek fire was impossible to extinguish using water, claim that the main ingredient of it was quicklime. They maintain that its contact with water caused a sudden reaction, which determined the power of Greek fire¹². The drawback of this view is the fact that quicklime-based compound substances, in order to acquire its incendiary properties, had to come in contact with water. Byzantine sources point out, though, that the use of naval fire did not necessarily have to involve meeting this *conditio sine qua non*¹³. What is more, experiments conducted in modern times have shown that, in the open sea, the reaction of quicklime and water has no effect of a potent enough explosive power¹⁴. Yet another idea linking the explosive reaction of naval fire to its contact with water was based on the view that its main ingredient was calcium phosphide. It is known that during its reaction with water phosphines, which ignite instantaneously, are released. Nevertheless, experiments carried out with this substance have shown that it does not cause effects in any way similar to those described in historical sources¹⁵.

c. Petroleum theory – Ultimately, the followers of the third view believe that the basic ingredient of naval fire was crude or refined oil (in other words petroleum). It should be admitted that this theory finds most support among contemporary researchers¹⁶. The hypothesis is strongly corroborated by the fact that the Byzantines had access to crude oil sources. They were located on the north-east coast of the Black Sea and Constantine Porphyrogenetos, for instance, mentioned that they could be found in Tmutorakan¹⁷. Oil flowed out naturally to the surface, where its volatile components began to evaporate into the air, as a result of which the remaining substance became viscid and difficult to set on fire. According to J. Haldon and M. Byrne, the Byzantines must have acquired the skill to collect the substance before the evaporation of its volatile and inflammatory ingredients¹⁸, determining the usefulness of this raw material as the basis for the production of Greek fire. Additionally, the scholars who promote the last theory also point out to the fact that such crude oil, both in its natural and refined form, when heated and fired under high pressure gives similar effects to those described in historical sources.

¹² It has been proved beyond the shadow of a doubt that quicklime was known and skilfully utilised by both the Byzantines and the Arabs in warfare – J.R. Partington, *op. cit.*, pp. 6-10, 14.

¹³ A. Roland, *op. cit.*, p. 660.

¹⁴ C. Zenghelis, *op. cit.*, p. 270.

¹⁵ N.D. Cheronis, *op. cit.*, p. 363; H.R. Ellis-Davidson, *op. cit.*, p. 70.

¹⁶ J. Haldon, M. Byrne, *op. cit.*, p. 92; H.R. Ellis-Davidson, *op. cit.*, p. 62 and others.

¹⁷ Konstantin Bagrjanorodnyj, *Ob upravlenii imperiej*, 53. 49-51, tekst, perevod, komentarij, ed. G.G. Litavrin, A.P. Novosel'cev, Moskva 1991.

¹⁸ J. Haldon, M. Byrne, *op. cit.*, p. 92.

It is equally important that the followers of the last theory support their point of view by means of a linguistic argument. Notably, they emphasize a direct connection between the nomenclature used to refer to crude oil and Greek fire in question. The researches notice that one of the names given to the flammable substance called popularly Greek, liquid or naval fire was also Median fire. Since Procopius of Caesarea reports that crude oil, usually called *naphta* (νάφθα), was sometimes termed Median oil¹⁹, the epithet directly adjoined to the terms referring to both the substances (i.e. the adjective Median) appears to connect them and prove that the weapon's chemical composition included petroleum termed either Median oil or *naphta*.

Last but not least, it seems that the final proof substantiating the theory lies in the below-quoted fragment from a ninth-century Latin manuscript preserved in Wolfenbüttel in Germany²⁰, which reads:

The material of the fire of the Tyree boys: naphta, tow, pitch, a fire arrow. Naphta [is] a species of balsam originating in Babilonia [Egypt] in humid places, which colloquially we call marisci, and it seems to swim there upon the water like fat. Also, there are two kinds of balsam. One originating from Mount Sinai, exuding from rock, whence "rock of oil"; the other twigs, which mixed together produce an inextinguishable fire. For when the Saracens proceed in war to a naval battle, having built a furnace right at front of the ship, they [Saracens?] set on it a copper vessel full of these things, having put fire underneath. And one of them, having made a bronze tube similar to that which the rustics call a squitiatoria, "squirt", with which boys play, they spray [it] at the enemy.

Greek fire surely included other substances on top of petroleum. It is maintained that additional components of naval fire were plant resins. They were admixed as a thickener of the oil itself and, additionally, as a medium maintaining and enhancing the power of the flame, making it also more sticky. In order to prove the last opinion the military treatise entitled *Praecepta militaria*, written after 963 AD and ascribed to emperor Nicephor Focas, is quoted, where (in connection with Greek fire) appears the term πῦρ κολλυτικόν²¹, which means adhesive or simply sticky fire.

¹⁹ Procopius, *Wars*, IV, 11, 36, ed. and transl. H.B. Dewing, London 1940. Cf. J.R. Partington, *op.cit.*, pp. 3-5, (esp. p. 3).

²⁰ *Wolfenbüttel, Herzog August Bibliothek, Cod. Guelf., 96 Gud. Lat., fol. 157r-v*. Latin text and its translation – J.H. Pryor, E.M. Jeffreys, *The Age of the ΔPOMΩN...*, pp. 614-615. The quoted text is critically important since it gives information not only about the composition of naval fire but also about the mode of its employment.

²¹ J. Kulakovskij, *Nikephori praecepta militaria ex codice Mosquensi*, „Mémoires de l'Académie impériale des sciences de St.-Petersbourg" VIII sér. Classe historicophilologique 9, 1908, p. 5.

Flame-throwing devices

Apart from the composition, the method of projection of Greek fire has not been pinpointed in sufficient detail either. Source-based research and quite recent experiments²² based on them have led to the conclusion that any flame-throwing device probably consisted of a few basic elements. The first of them was a siphon (σίφων), a kind of a pump, whose role was to increase the pressure of crude oil²³ which was stored in an airtight container kept hot with a little brazier-like boiler termed *propyron* (πρόπυρον) located underneath²⁴. The substance, when heated to a proper temperature and pressurized adequately, was fired in a given direction²⁵ with a nozzle covered in bronze and mounted on a swivel, i.e. *strepton* (στρεπτόν)²⁶. At the moment of discharge it was ignited at the mouth of the nozzle by a source of flame, for instance by a lamp. The flames released from the device are assessed to have reached over 1000°C. The range of the weapon is thought to amount to 15 metres²⁷.

High pressure and temperature accompanying the discharge of naval fire made the procedure of using it dangerous and even life-threatening. For this reason heat shields known as *skoutaria sidera* (σκουτάρια σιδηρά) or *boukolia* (βουκόλια) were used to protect those operating the Byzantine flame-throwers²⁸. The fact that historical sources do not provide any information about accidents²⁹ might indicate that the shields made an effective cover and also that the operators attending to the equipment (σίφωνατῶρ) were well (if not perfectly) trained.

Devices characterised above were used mainly on Byzantine warships. This way of deploying them led to the fact that one of the terms most commonly used in the present day's scholarly and popular dissertations to refer to the weapon was naval fire. However, there also existed manual flame-throwers, i.e. *kheirosiphnes* (χειροσίφωνες), whose use on battlefield is confirmed for the 9th and 10th century AD. They were described by emperor Leo VI³⁰.

²² J. Haldon („Greek fire", pp. 297-315) gives details of the experiments.

²³ J. Haldon, M. Byrne, *op.cit.*, p. 93, esp. note 5-6; contra T. Korres („Hygron pyr", pp. 136ff, 142ff), who argued that no device of the sort was used; instead, a throwing machine was utilized, which would fire clay containers full of Greek fire at the enemy. A discussion with Korres' point of view cf. J. Haldon, „Greek fire"..., pp. 294-296.

²⁴ J. Haldon, M. Byrne, *op.cit.*, pp. 93-94, note 8; J. Pryor, E.M. Jeffreys, *The Age of the ΔPOMΩN...*, p. 617.

²⁵ There is no source mention of any aiming device nor any remains of it has been discovered so far.

²⁶ J. Haldon, M. Byrne, *op.cit.*, p. 93, note 7.

²⁷ J. Haldon, *op. cit.*, p. 297-315.

²⁸ J.H. Pryor, E.M. Jeffreys, *The Age of the ΔPOMΩN...*, pp. 624-626.

²⁹ J. Haldon, M. Byrne, *op. cit.*, p. 96; J.H. Pryor, E.M. Jeffreys, *The Age of the ΔPOMΩN...*, pp. 627-628.

³⁰ *The Tactica of Leo VI*, XIX 6, ed. et transl. G.T. Dennis, Washington 2010; cf. J.H. Pryor, E.M. Jeffreys, *The Age of the ΔPOMΩN...*, p. 617.

Ultimately, it is known that the Byzantines would sometimes resort to throwing or shooting at their enemies earthenware pots, usually termed *khytrai* (χύτραι)³¹, which were filled with a fluid concoction that, as we surmise, was the same or similar in composition to Greek fire.

Around the time of the Fourth Crusade, however, mentions about using naval fire started to gradually become less frequent. This drop appears to prove that, for a number of general reasons, the Byzantine military fleet and therefore naval fire ceased to be as important for the Byzantines in warfare as it used to be³². Additionally and contrary to popular belief, it was not so perfect a weapon³³. Nevertheless, one has to admit that in the Middle Byzantine period Greek fire was the implement of war that brought the imperial military significant successes. Its crucial role is best visible in the staggering victories won by the Byzantine ships over numerous Arab fleets³⁴. The role of naval fire cannot be diminished even by some modern scholarly suppositions that the Arabs also learned how to use the weapon in the 830's AD³⁵. Not only did it wreak unprecedented damage to the Arabs, but also aroused fear in the enemies' ranks. Even if the Arabs had known naval fire, they would have been incomparably worse than the Byzantines at using it effectively.

The above presented views concerning the composition and the method of shooting Greek fire have led us to the conclusion that our knowledge on the subject is neither especially broad nor thorough. The limited competence we have today, in turn, is a consequence of the attitude of the Byzantines, who very efficiently strived to keep the methods of production of the substance secret. Neither has it been proved that they allowed their enemies to permanently come into possession of their weapon.

Bulgarians and Greek fire

In scholarly literature there is an ongoing discussion, whether the essence of the above-discussed Byzantine

invention was known to other peoples both of the Byzantine commonwealth as well as their rivals. Fairly recently the question of the Bulgarians' familiarity with Greek fire has been raised by the already mentioned G.N. Nikolov³⁶. The scholar from Sophia, though cautiously, formulated a thesis that the Bulgarians learned the Byzantine secret. Accordingly, we would like to devote a certain amount of our attention to this issue and express our opinion as far as his interpretation of source material is concerned.

It is true that the Bulgarians were able to see Greek fire in use relatively early and thereby appreciate (or rather fear) the effects of its employment. G.N. Nikolov has rightly noticed that such a situation must have happened during the Arab siege of Constantinople between 717 and 718 AD³⁷. At that time, as we know, the Bulgarian army was allied with the Empire and supported the Byzantines in their battles with the Arabs of the Umayyad Caliphate³⁸, against whose navy the Byzantines used Greek fire³⁹.

Less than 100 years later, in November 812 AD, supplies of Greek fire were intercepted in Mesembria by the Bulgarians led by Krum the Horrible, khan of Bulgaria⁴⁰, who entered the city by force. It was exactly at this occasion that the Bulgarian army pillaged this important Byzantine port on the Black Sea⁴¹. Beside their rich loot, the

³⁶ G.N. Nikolov, *Bułgarzy...*; idem, *Greek fire...*

³⁷ On the developments in connection of that memorable siege of Constantinople cf. R. Guiland, *L'expédition de Maslama contre Constantinople (717-718)*, [in:] idem, *Études byzantines*, Paris 1959, pp. 109-133; W. Treadgold, *A History of the Byzantine State and Society*, Stanford 1997, pp. 347-349; P. Speck, *Kaiser Leon III. Die Geschichtswerke des Nikephoros und des Theophanes und der Liber Pontificalis. Eine quellenkritische Untersuchung*, vol. I, *Die Anfänge der Regierung Kaiser Leons III.*, Bonn 2002, pp. 233ff.

³⁸ The Bulgarian army played an important role in defeating the deadly foe of the Byzantines because they dealt the deadly blow to the Arabs by attacking their rear positions. As a result of those attacks, the Arab siege of the city of Constantinople was lifted on the 15th of August 718. On the Bulgarian participation in the fights against the Arabs at Constantinople – V. Gjuzev, *Učasteto na bālgarite v otblaskvaneto na arabskata obsada na Carigrad prez 717-718 g.*, "Istoričeski Pregled", Vol. 29, 1973, No. 3, pp. 28-47; P.A. Yannopoulos, *Le rôle des Bulgares dans la guerre arabo-byzantine de 717/718*, „Byzantion”, Vol. 67, 1997, pp. 483-516; B. Cecota, *Bułgarzy wobec arabskiego oblężenia Konstantynopola w latach 717/718*, „Balcanica Posnaniensia”, Vol. 18, 2011, pp. 11-22.

³⁹ Theophanes, AM 6209, p. 396, 8-12, 397, 9-12; *Symeonis Magistri et Logothetae Chronicon*, rec. S. Wahlgren, *Berolini-Novii Eboraci* 2006, p. 184.

⁴⁰ An informative portrait of the Bulgarian ruler cf. M.J. Leszka, *Wizerunek władców pierwszego państwa bułgarskiego w bizantyńskich źródłach pisanych (VIII – pierwsza połowa XII wieku)*, Łódź 2003, pp. 36-55.

⁴¹ The siege of Mesembria is a military development belonging to the campaign conducted by khan Krum in the year 812 against the Byzantine Empire, which was at that time ruled by emperor Michael I Rangabe. On the war between the Byzantines and the Bulgarians cf. W. Treadgold, *The Byzantine Revival 780-842*, Stanford 1988, pp. 181-185; I. Božilov, V. Gjuzev, *Istoriija*

³¹ J.R. Partington, *op. cit.*, p. 14.

³² J. Haldon, *op. cit.*, p. 316; J.H. Pryor, E.M. Jefferys, *The Age of the ΔΡΟΜΩΝ...*, pp. 630-631. One should also remember that Byzantine access to the areas from which ingredients for the production came was gradually more and more limited. For the fact (increasingly smaller availability of components) it is also possible that the secret of Greek fire had been by that time (i.e. the very beginning of the 13th c.) entirely forgotten by the Byzantines themselves.

³³ Greek fire-throwers had a limited range and were dependant on good weather conditions, that means the favourable direction and power of wind, wave height etc. Cf. J.H. Pryor and E.M. Jefferys' (*The Age of the ΔΡΟΜΩΝ*, p. 384) opinion on that matter. We have some reliable information that the enemy navies were eventually able to resist the danger by remaining out of its range and protecting the most vulnerable parts of the ship with felt or hides soaked in vinegar – *ibidem*, p. 617.

³⁴ J. Haldon, *op. cit.*, p. 316.

³⁵ The secret of Greek fire was allegedly revealed by a certain Euphemios, the turmarches of the theme Sicily – J. Haldon, „*Greek fire*”..., p. 310.

Bulgarians came into possession of 36 brass siphons and considerable quantity of liquid fire that is projected from them...⁴². Since from Theophanes's chronicle it can be inferred that the Bulgarians captured both shooting devices as well as supplies of Greek fire, G.N. Nikolov has formulated the view that as a result of the capture of Mesembria the Bulgarians acquired the knowledge of one of the great mysteries of the Byzantine army of the early Middle Ages⁴³.

Though G.N. Nikolov's conclusion seems to us to be generally tenable, some aspects of his line of reasoning require to be re-interpreted since, even if it is in our opinion proved beyond the shadow of a doubt that the Bulgarians captured what was essential to make full and effective use of liquid fire, there remains a crucial question, whether the captors had enough knowledge and adequate skills to use the seized flame-throwers to defeat an enemy and whether they were familiar with the ingredients of the substance projected from the devices (and thereby were able to produce the incendiary substance themselves). We must say that, in our opinion, neither is as certain as the Bulgarian scholar implies.

First, it should be remembered that the equipment intercepted by the Bulgarians was deployed on Byzantine warships and for the reason of its very construction was most probably unfit (due to its cumbersomeness) to be used on land, while at that time the Bulgarians themselves did not possess any navy⁴⁴. In order to make use of this military apparatus, the Bulgarians would have had to be able to introduce alterations to the equipment, which would have adjusted the devices to their new warfare applications. However, it remains to remind the reader that no information about such Bulgarian activities has been extant.

The second argument is even more important. Preserved literary sources do not provide any information about the Bulgarians' use of flame-throwers either at a moment relatively close to the capture of Mesembria nor within the time-span shorter than approximately 170 years from the above mentioned military development. The first occasion, on which the Bulgarians could really take advantage of Greek fire, as G.N. Nikolov also admits, was the Bulgarian attempt to take the fortress of Moria by emperor

Basil II. The battle itself took place at a date which has not been pinpointed yet. A few proposals suggested so far are the years 986, 1004, 1015-1916⁴⁵. However, we consider that the question which of the dates is correct does not play a significant role as far as our line of reasoning is concerned, since a simple calculation conducted in connection with the already mentioned dates demonstrates clearly that from the capture of Mesembria to the first known utilisation of Greek fire by the Bulgarians passed between 174 and 203 years. Accordingly, a question can be raised, why the Bulgarians, who had supposedly acquired the equipment and the knowledge indispensable to make use of liquid fire, did not take any advantage of such a military asset at an earlier date.

Thirdly, we doubt whether it was so easy to build and operate the flame-throwers. The problems which modern scholars have had trying to re-construct the fire throwing equipment demonstrate that, without expert knowledge or an instruction manual, the use of siphons was difficult, if not impossible. It is obvious that without expertise as for such parameters as the temperature to which naval fire needed to be heated or the pressure at which the valve should be opened to effectively throw the pressurized liquid, the devices captured in Mesembria would have been useless.

Fourthly, it should be taken into consideration that even if we assume that the Bulgarians had found, among the Byzantine captives, a person, who was not only capable of operating the siphons but also willing to pass this knowledge to the enemy of the Empire, there is still the question whether the Bulgarians were able to learn from them the secret of the formula of liquid fire. It is highly likely that in Mesembria only limited supplies of ready-to-use substance were stored with which the imperial warships stationed there were provided⁴⁶. Neither do we possess any indication of the fact that along with the naval fire supplies in Mesembria there were specialists knowledgeable about how to produce the incendiary liquid projected by means of the equipment intercepted from the ships⁴⁷. Having that in mind, though we could generally agree with G.N. Nikolov's claim that in Bulgaria: *The supply of ingredients necessary to produce "Greek fire" (...) was limited, yet not cut off in its entirety*⁴⁸, we should also opine that after the capture of Mesembria the Bulgarians were not in the know as to in what proportions exact ingredients of Greek fire were to be mixed to produce the weapon. Neither can we agree with the suggestion immanent in the hypothesis promoted by the Bulgarian

na srednovekovna Bălgarija VII–XIV vek, Sofija 2006, pp. 132-133; P. Sophoulis, *Byzantium and Bulgaria*, pp. 775–831, Leiden 2012, pp. 221-234.

⁴² Theophanes AM 6305, p. 499. J.H. Pryor, E.M. Jeffreys (*The Age of the ΔΡΟΜΩΝ...*, p. 609) wrongly maintain that both the siphons as well as the liquid fire were seized in Develtos, while in fact Theophanes, writing on Mesembria, en passant mentions also the earlier capture of Develtos.

⁴³ G.N. Nikolov, *Bulgarzy...*, s. 451; idem, *Greek fire...*, p. 53.

⁴⁴ R. Rašev, *Părvoto bălgarsko carstvo i moreto*, [in:] *Srednovekovna Bălgarija i Černomorieto (Sbornik dokladi ot naučnata konferencija Varna–1980, sās. A. Kuzev, ed. T. Jordanov, Varna 1982, pp. 47-56; K. Marinov, Zadania floty cesarskiej w wojnach bizantyńsko-bulgarskich (VII-XI w.), [in:] Byzantina Europaea...*, p. 382.

⁴⁵ On the datation of the events – G.N. Nikolov, *Bulgarzy...*, p. 452, note 15; idem, *Greek fire...*, p. 54.

⁴⁶ J. Haldon, *op. cit.*, p. 309.

⁴⁷ Cf. A. Roland's (*op. cit.*, pp. 663-664) conclusions concerning the issue.

⁴⁸ G.N. Nikolov, *Greek fire...*, p. 53; idem, *Bulgarzy...*, p. 451.

researcher that the very fact of possessing certain amount of liquid fire also meant the Bulgarians' discovery of its composition. Quite on the contrary, we can assume that an organoleptic inspection of the compound substance the Bulgarians were capable of conducting would only have helped recognize its basic ingredients, but it certainly would not have made it possible to estimate their exact proportion in the incendiary concoction. Therefore, we have to disagree with G.N. Nikolov and come back to the opinion that the Bulgarians did not learn the secret of liquid fire as a consequence of capturing some amounts of the substance and siphons in Mesembria in 812 AD, and thereby rather support the (unfavorable for the Bulgarians and G.N. Nikolov's hypothesis) conclusions expressed by such scholars as A. Roland⁴⁹, J. H. Pryor and E.M. Jeffreys⁵⁰.

Next references in which one may discern some traces of the Bulgarians' familiarization with liquid fire (an which were analyzed by G.N. Nikolov) can be traced back to the last three decades of the 10th century and the beginning of the 11th century. The first of them is connected with military developments at Dorostolon, which occurred in the 10th century. There is no doubt that the Bulgarians certainly witnessed the use of liquid fire⁵¹ in 971 AD during the Byzantine siege of the fortified city, to the walls of which emperor John I Tzimiskes brought the Byzantine army to defeat the troops which had taken refuge inside the fortified city. The defenders of the fortress were the Rus, led by Svyatoslav I of Kiev⁵². As Leo the Deacon⁵³ reported, in order to even more effectively attack the city walls, the Byzantines deployed on the Danube (on which the city was situated) warships equipped with Greek fire. The Rus, the chronicler maintains, were extremely afraid of the weapon, since they well remembered the fate of Igor's expedition to Constantinople back in 941. It was when the ships attacking the capital of Byzantium were burnt with what was termed Median fire, so powerful, as we learn from the source, that it was able to: *reduce even stones to ashes*⁵⁴. Now a few

words of comment on the cited word of Leo the Deacon. Though the quoted fragment is fairly informative about the developments at Dorostolon and clearly shows that naval fire was still in use in the Byzantine navy in the early 70s of the 10th century (just as it was also used against the Rus in the 40s of the same century), the narrative of the chronicler does not include any hints substantiating the Bulgarian expertise in the field of Greek fire production nor its military use. The source only demonstrates that liquid fire was used before the very eyes of the Bulgarians and that the Rus were equally (or even more) afraid of the weapon as the Bulgarians themselves.

Two other references related to our topic come from the time of the long-lasting struggles of Basil II with the Bulgarians. The first one can be found in Kekaumen's work and concerns the Byzantine siege of the fortress of Moria, which has been already mentioned before. According to the author, the Byzantine army erected around Moria a powerful earthen wall, whose internal structure was built of timber. One night, the defenders of the stronghold organised a sortie, whose aim was to destroy the Byzantine fortifications. We are informed that they were carrying *ῥῆτινην καὶ πυρεκβόλους*⁵⁵. With their help they set the internal part of the Byzantine fortification on fire, which eventually caused its collapse. The damage was so severe that in the wake of the event the imperial forces were inexorably compelled to lift the siege.

Once again, though the above presented narrative appears to include some elements suggesting the Bulgarians' use of some incendiary devices, a closer look at this account does not indicate that it ought to be treated as an irrefutable confirmation of the Bulgarians' knowledge of Greek fire. We do not know, in fact, what the mentioned *πυρέκβολοι* were and whether they would throw Greek fire⁵⁶ or simply launch incendiary projectiles. Moreover, we would like to draw the attention of the reader to the mention of resin included into the list of weaponry taken by the Bulgarians to attack the Byzantines. Since the author

⁴⁹ A. Roland, *op. cit.*, p. 663.

⁵⁰ J.H. Pryor, E.M. Jeffreys, *The Age of the ΔΡΟΜΩΝ...*, p. 609.

⁵¹ G.N. Nikolov, *Bulgarzy...*, pp. 453-454; idem, *Greek fire...*, pp. 55-56. We would like to support the Bulgarian academic's supposition by adding that the Bulgarians could observe the Byzantines' struggle with the Rus not only because the battle was taking place on their territory but also because they supported those enemies of the Empire during that military operation.

⁵² On the struggles at Dorostolon for instance cf. S. McGrath, *The battles of Dorostolon (971). Rhetoric and reality*, [in:] *Peace and war in Byzantium. Essays in honour of George T. Dennis, S.J.*, eds. T.S. Miller, J. Nesbitt, Washington 1995, pp. 152-164.

⁵³ *Leonis Diaconi Caloensis Historiae*, IX, 2, 10, rec. C.B. Hase, Bonnae 1828 (hereinafter: LD).

⁵⁴ LD, IX, 10, p. 156 (transl. – *The History of Leo the Deacon. Byzantine Military Expansion in the Tenth Century*, introduction, translation., annotations A-M. Talbot, D.E. Sullivan, with assistance of G.T. Dennis and S. McGrath, Washington 2005, p. 198).

⁵⁵ *Sovety i rasskazy Kekavmena. Sočinenia vizantijskogo polkovodca XI veka*, ed. G.G. Litavrin, Moskva 2003, pp. 196. 32 – 198. 12. The story told by Keukamenos, if it was true, would testify to an unprecedented negligence on the part of the Byzantine troops, who not only did not guard the fortification they had built but also failed to notice the fact that it was set on fire. The story is even more incredible, once we remember that the developments occurred at night. Even if we accepted the Byzantine author's explanation, that the fire was merely kindling, it is hard to believe that there would have been no visible glow nor perceivable smoke.

⁵⁶ J. Haldon and M. Byrne (*op. cit.*, p. 97) argue that the device was entirely different in its nature and was similar to a syringe squirting either liquid fire or other noxious substances to kill or merely repel the enemy. Though the two scholars claim that the mixture projected from this portable weapon was not meant to be ignited, J.H. Pryor and E.M. Jeffreys (*The Age of the ΔΡΟΜΩΝ...*, p. 627) opine that this kind of devices could also fire a flaming substance.

clearly stated that solely resin was brought by the attackers to the battle scene, then the substance cannot have been understood by him as a component of liquid fire but, as we suppose, a separate means of incendiary qualities. Our line of reasoning is supported by the fact that, in the context of the developments at Moria, Kekaumens did not make any remark of Greek fire whatsoever. Of course one cannot exclude that the *πυρέκβολοι* mentioned in the narrative were in fact the so-called *χειροσίφωνες*, which had been known to the Byzantines, as we have already mentioned, since the 9th and the 10th century. The latter supposition, however, cannot be confirmed by historical sources, which was also obvious to Nikolov, who therefore remained very cautious in this respect⁵⁷.

The last instance of using Greek fire in the battles between the Byzantines and the Bulgarians over the relevant period is the siege of Vdin (today's Vidin). It took place in 1002-1003 AD and John Skylitzes reports⁵⁸ that during the military developments at the city the Byzantine warships threw fire in the direction of the fortress. It is difficult to state to what extent the weapon contributed to the final capture of the fortress by the Byzantines, especially because from our source it follows that the defenders were able to cope with the danger. Notably, Michal Devolski wrote in a footnote to John Skylitzes's work: *ἐνθα καὶ τῶν Βουλγαρικῶν ἀρχόντων διεδείχθη ἡ πολυπειρία εἰς ἔν γὰρ ἀγγεῖον παμπληθὲς ὀμιλοῦντες τὸ Μηδικὸν πῦρ διὰ τοῦτου ἐσβέννου*⁵⁹.

As for the quoted source relation, the behaviour of the defenders of Vidin clearly shows that they knew how to act

in order to reduce the damages done by Median fire, which, obviously, must have been a result of their prior experience in this matter. We, however, represent the line of reasoning that their familiarity with the impact of Greek fire does not prove their knowledge of the mixture's components and argue that neither the narrative of the Byzantine historian nor Michal Devolski's remark prove that the Bulgarians knew formula of the incendiary liquid in question.

Trying to recapitulate our discussion, we conclude that the above presented considerations show that Greek fire still remains one of the mysteries of the past. Unfortunately, we are, up to the present moment, still not certain about its composition and the exact method of throwing it. Neither can we be sure that anyone, except for the Byzantines, acquired the skill and competence to produce it and use it on battlefield. The latter assumption fully applies to the alleged Bulgarians' familiarity with its production and employment in warfare. Historical sources only allow us to opine that the Bulgarians saw Greek fire in use, seized (at the beginning of the 9th century) a certain amount of the substance as well as intercepting some flame-throwers, which were used by the Byzantine navy. However, the analyzed sources do not give any grounds for proving that the military development in Mesembria contributed to the Bulgarians' coming into possession of the secrets of production pertaining to Greek fire itself and manufacturing the equipment necessary to use it with deadly results on a marine or terrestrial battlefield.

Streszczenie

Morski ogień/ Płynny Ogień. Bizantyńska „cudowna” broń i kwestia jej znajomości przez Bułgarów w VII–XI w.

Celem artykułu było przedstawienie istniejących w nauce poglądów dotyczących ognia greckiego, jak również ustosunkowanie się do tezy wysuniętej przez Georgi N. Nikołowa, znanego bułgarskiego historyka, że Bułgarzy posiadli w początkach IX w. umiejętność jego produkowania i używania w warunkach bojowych. Miało się to stać po zdobyciu Mesembrii w 812 r. przez wojska chana Kruma, w której Bułgarzy weszli w posiadanie bizantyńskich zasobów ognia greckiego i urządzeń do jego wystrzeliwania.

Prześledzenie współczesnych teorii dotyczących ognia greckiego prowadzi do wniosku, że mimo wysiłku wielu badaczy – które nie sprowadzają się jedynie do analizy

dostępnych źródeł, ale obejmują również eksperymenty – nie mamy pewności, co do szczegółów jego składu i sposobu wystrzeliwania. Natomiast można zgodzić się, co do tego, że podstawowym składnikiem „morskiego ognia” była ropa naftowa. Przy pomocy rodzaju pompy (*σίφων*), podnoszono ciśnienie ropy, znajdującej się pojemniku, który podgrzewany był przy użyciu małego podgrzewacza (*πρόπυρον*). Podgrzana do odpowiedniej temperatury i znajdująca się pod właściwym ciśnieniem substancja, była wystrzeliwana w pożądanym kierunku przez rurę zamocowaną przegubie (*στρεπτόν*). W chwili, gdy opuszczała ona rurę była zapalana. Wyrzucany z tego urządzenia płomień mógł uzyskać ponad 1000 °C.

Przeprowadzona analiza źródeł (m.in.: Teofanes, Leon Diakon, Kekaumenos) nie daje podstaw do wniosku, że Bułgarzy poznali skład ognia greckiego i szczegóły techniki jego wystrzeliwania. Pozwala jedynie na stwierdzenie, że z pewnością widzieli ogień grecki w użyciu, weszli w posiadanie jego pewnej ilości, a także urządzeń do jego wystrzeliwania.

⁵⁷ G.N. Nikolov, *Bułgarzy...*, p. 453; idem, *Greek fire...*, p. 55.

⁵⁸ *Ioannis Scylitzae Synopsis historiarum*, rec. I. Thurn, Berolini et Novi Eboraci 1973, p. 346.

⁵⁹ V. Gjuzeliev, *Izvori za srednovekovnata istorija na Bălgarija (VII-XV v.) v avstrijskite răkopisni zbirki i archivi*, Vol. 1, *Bălgarski, drugi slavjanski i vizantijski izvori*, Sofija 1994, p. 46.

