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## FIGHTING THE LOCAL FOE. THE BRITISH PREVENTIVE MEASURES AGAINST MALARIA ON THE MACEDONIAN (SALONICA) FRONT

**Abstract:** The occurrence and spread of malaria amongst the warring parties on the Macedonian<sup>1</sup> front brought about the appearance of completely new approaches in its treatment and prevention among the soldiers on both sides of the front line. The British experience in preventing the spread of malaria is a very interesting topic for analysis. The Macedonian front became an enormous experimental field for malaria research and experiments carried out by British medical and military personnel. The impact malaria had on the readiness of British soldiers concerning their combat activities on the front forced the command structures to undertake preventive measures in order to halt its spread. Thus, the British military command in Salonica became involved in draining swamps, clearing streams, oiling, and other methods of treating breeding places, fumigation and spraying, mosquito-proofing the huts and the carrying quinine prophylaxis.

**Keywords MeSH:** Malaria, quinine prophylaxis

**Non-MeSH:** Salonica, Macedonian front, British

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<sup>1</sup> When we refer to Macedonia in this text, we want to emphasize that it pertains to the part of the region that was incorporated within the Kingdom of Greece after 1913.

A connection between war and malaria was well-recognized, as Christophers wrote, before the outbreak of WWI, but the Macedonian experience was one of the greatest medical surprises of the War. [1 p283] During the 19<sup>th</sup> century and at the beginning of the 20<sup>th</sup> century malaria had made an appearance in various military conflicts – the Abyssinian expedition, the Ashanti expedition, the Chinese-Japanese War, the Spanish-American War, the Sudan War, the Russo-Japanese War – resulting in deaths amongst the military forces of the warring parties. In this context we will mention the challenges posed by malaria during and in the aftermath of the Spanish-American War. Malaria posed problems for the American soldiers during the war with Spain in 1898. The issue with malaria persisted even after the ending of the war. Major William Gorgas was appointed as a chief sanitary officer in Havana and was charged with eradicating of malaria. Under his auspices and instructions diseased patients were isolated by screening them with mosquito netting, buildings were fumigated to kill mosquitoes, and breeding sites were drained or covered with kerosene. These measures proved very successful. [2 p16] Another intriguing example involves the British efforts to cope with malaria during and after the war with the Mahdists in Sudan. After the ending of the war, the British government appointed Andrew Balfour as a Medical Officer for health in Khartoum. As his primary task, he committed himself to focusing on the eradication of mosquitoes, recognizing them as the fundamental factor in the spread of malaria, which posed a threat to the local population. The strategy for malaria eradication involved identifying and addressing its breeding sites, a task to be carried out by a team of ‘sanitary workers’ who were not presently available in the country. Despite this limitation, he embraced the idea of a ‘Mosquito Brigade,’ comprising primarily two Sudanese men. These individuals underwent rapid training to identify mosquitoes, their eggs, larvae, and pupae, and to distinguish Culicidae from other insects. [3 p167-8] As such, the impact of malaria on the military, during and after the war, was not at all surprising for the medical and military staff at the beginning of WWI.

Malaria presented a serious danger on the front lines, both in terms of the health and well-being of the soldiers, and in terms of the combat readiness on both sides. Every soldier was vital when it came to the battle lines. The territory of the Macedonian front, where the battles were being fought, was predisposed to certain diseases, especially malaria, which was widespread in the swamplands. Here, I shall provide comments made by some of those involved concerning the appearance of malaria. Amelia Peabody Tileston remarks that many of the soldiers suffered from malaria. It should be noted that she herself was also taken to hospital in Salonica, having fallen ill from this disease. [4 p99] Even though Amelia was infected, in her letter we see that she is not at all perturbed by this predicament; on the contrary, she felt she would recover. This did not mean that her state was not serious; doctors were concerned about her health, since the illness had weakened her heart. She recovered, however, and continued to care for the soldiers.

For Harold Lake, malaria was the greatest foe of the armies of the Entente Powers. He published his book dedicated to the British effort on the Macedonian front in 1917, and the information he provides about malaria is very interesting. He remarks

that when soldiers were sent to Salonica, in addition to all the other battles they were engaged in, they also fought a war against mosquitoes, as these insects were carriers of the disease. As a precautionary measure against this dangerous disease, soldiers were given quinine therapy, which though not very popular, was nonetheless essential. [5 p208-9] Lake also notes that though relapses were possible, people were becoming better at coping with it.

For Price, Macedonia was one of the most malaria-prone places in the world. This was due to the vast wetlands in the region, as well as the abundance of mosquitoes. Although, as he writes, extensive preventive measures were taken, including medication and drying up wetlands, the troops, nonetheless, succumbed to this disease. He felt that the worst of it was that once infected, malaria stayed with you. Seligman also notes that malaria, together with dysentery, was the greatest health risk for the soldiers. He felt that even soldiers not infected by malaria were "affected by an appalling lassitude." [6 p105] Ivor Davies described the effects of malaria over his battery: "At night the air was thick with mosquitoes, many of the battery personnel went down with malaria and dysentery... The battery strength was rapidly reduced down to one officer... a few NCOs and a total of seventeen gunners and drivers". [7 p334] Malaria, much more than injury, was the main worry of Allied soldiers, who found themselves embroiled in a 'war against the mosquito and all his works'. Songs from the front referenced it, and it even featured in enemy propaganda. One Bulgarian leaflet threatened British troops with the medical weakness of the terrain, boasting, "You are in the unhealthiest spot in Europe. We shall stay on our hills, and let God do the rest." [8 p107]

Scholars and researchers who deal with the military operations on the Macedonian front during WWI are determined that malaria was some kind of unofficial or hidden enemy for the warring parties on the front line. The Command of the British Salonica Army realized that treating malaria was one of the dominant factors in their military operations. A senior officer of the British medical service wrote: "In any attack or even in a strategical move, the great question for the particular G.O.C. in charge of the operation always was, How many fit men can I rise for the prosecution of the operation; and during the time of operation, how many men are likely to fall out with disease, chiefly malaria?... Many of our failures would have had a very different end had they been entrusted to fit troops... To have brought the campaign to a speedy end, a huge army would have been needed... The bigger the army, the quicker it went down with malaria and we couldn't have hospitals enough to house a million men." [9 p294] According to Owen, nobody could possibly have foreseen that impressive battalions of thousands strong would be struck down wholesale and in a few days or weeks be reduced to a few healthy men. [10 p175] These words of the medical officer raise the question about the numbers of British soldiers infected by malaria during the military operations in Macedonia. According to Falls, there were 162,517 British soldiers admitted to hospitals, with 787 fatalities [9, p351]. Ogilvie is more detailed in his presentation, based on preliminary British statistics, about the number of soldiers infected and cured in hospitals. According to him, in 1916 there were 31,059 soldiers admitted in various hospitals; 190 of them died. In 1917 we may note a serious increase in the number of soldiers admitted in hospitals – 71,413 soldiers, and 237 fatal-

ities. In 1918 there is a decrease in the number of soldiers treated in hospitals – 59,087 in all, although the number of deaths has increased to 271. [11 p17] Phear felt that these numbers provide a very incomplete picture of the incidence of malaria, since they include only admissions to general hospitals, stationary hospitals and casualty clearing stations. He noticed that this number did not include cases treated at field ambulances and discharged as fit from there, nor cases returning to duty after treatment by regimental military officers. [12 p60]

The great number of malaria-infected soldiers had a profound impact on the readiness of the military units of the warring forces. One British battalion was reportedly reduced to a single officer and 19 men. Facing disaster, General Sarrail complained that “My army is immobilized in the hospitals.” [8 p108] Goodall emphasized that there were far more Allied casualties to malaria on the Balkan front than to enemy action. [13 p173]

These words and numbers logically raise the question of whether the British military authorities had been informed of the dangers of malaria before landing their troops in Macedonia. Owen is very frank and clear about the awareness of the British military authorities concerning the existence of malaria on the Macedonian front. He admits that the British did know when they went to Macedonia that it was a malaria-infested country. However, nobody could have possibly realized how deadly, as Owen noted, the Struma valley was. [10 p175] The possibility of the occurrence of malaria was recognized by the British military and in early 1916 steps were taken to cope with this disease. [14 p230]

### **Geography and climate**

Rossati and others consider that among five major factors characterizing *Anopheles* population dynamics (temperature, moisture, nutrient competition, predation and diseases, and dispersal), two are strictly connected with climate. [15 p 99] According to Harrison, the warring troops were stationed in and moved through different diverse ecological areas. [16 p109] His remark leads us to the question of the Macedonian geography and climate during WWI, and their impact over the existence of malaria. It is interesting to see the depiction of the Macedonian climate and geography by those who had to deal with the problems of malaria during the War. The problems facing the British commanders with malaria in Macedonia were linked to the geographical conditions and climate as well. Ogilvie felt that Macedonia provided an excellent environment for mosquitoes – large areas of stagnant or slowly moving waters were favorable mosquito-breeding places, and the temperature conditions worked in their favor, as well. In his assessment, the southern parts of Macedonia were one of the most malaria-infected districts in the world. [11 p17] Some of the participants on the Macedonian front, who dealt with the problem of malaria, portrayed Macedonia as a region with two types of countryside. Hamilton wrote that the first type was the low-lying, thickly vegetated and swampy valleys, on which were scattered villages made of mud-brick houses, and the other type was the mountainous areas traversed by deep nullahs. [17 p361] Macpherson defined Macedonia as a country with hot sum-

mers and cold winters, the extremes being fairly great. In his observations, the maximum summer temperatures in August reached 94° F (34,4° C), whereas in January and February the maximum temperatures were about 52° F (11° C). [14 p227] The wet season commenced in the autumn and extended through the winter, while the dry summer was broken up with thunderstorms and downpours, all of which were crucial for the behavior of the malaria-carrying mosquitoes. Like the others, Macpherson also divides Macedonia into two types of countryside – ‘the low-lying marshy, river and lake districts along the circle of lakes and in the Vardar delta, and the high, hilly country around and within the circle.’ [14 p230]

The natural characteristics of the area of Macedonia occupied by British troops were favorable for the occurrence and spread of malaria. Willoughby and Cassidy described Macedonia as a mostly mountainous country with many separate heights in each range. [18 p24] Unlike others, they paid attention to the local Macedonian vegetation, and in their opinion the abundant vegetation along the banks of the streams and lakes was useful for the mosquitoes as a resting place by day. [18 p27] Regarding the climate conditions, they reiterated that the summers favored mosquito life.

### **The reason for malaria – mosquitoes and parasites**

Malaria is the most common parasite disease in the world. The parasite is transmitted to the human host by mosquitoes of the genus *Anopheles*. [15 p93] According to Phear, the most formidable enemy that British troops had on the Macedonian front was the mosquito – “Compared with the havoc wrought among our troops by malaria, the casualties from wounds, even including the period of greatest military activity, sank into relative insignificances.” [12 p59] After detecting the problem of the existence of malaria in Macedonia, the British medical officers found the source of this disease in the area around Salonica. The main reason for malaria in Macedonia, and all around the world, were mosquitos, which transmitted this disease. Macpherson located five types of anopheline mosquitoes in Macedonia – 1. *A. maculipennis*, 2. *A. superpictus*, 3. *A. bifurcatus*, 4. *A. sinensis* (*pseudopictus*), and 5. *A. algiriensis*. [14 p231] *A. maculipennis* was prevalent in the Struma valley, the Vardar valley, the lakes, and the Vardar delta, as well. It is interesting to note that even a Macedonian village house could provide an ideal hibernation retreat for mosquitoes. [14 p239] Macpherson felt that the native Macedonian population undoubtedly created the original reservoir from which the troops were infected with malaria in 1916, but in subsequent malaria-rich seasons, the troops were infected to such an extent that they formed their own sources of infection from the mosquitoes. [14 p242] Concerning the inhabitants of Macedonia as a source of malaria, Willoughby and Cassidy concluded that “...the mosquito has another advantage as a malaria transmitter in the state of the inhabitants...Fortunately, there are not many natives near the front.” [18 p28-29] Harrison points out to another source of malaria. According to him, there were two species of the parasite that caused malaria. The first one was the *Plasmodium vivax* parasite, which produced symptoms in 48-hour cycles; the second one was the *Plasmodium falciparum* parasite. [16 p109-119] Both of these parasites initiated the spread of malaria and wreaked havoc during

and following the patients' recuperation. A report concerning the problem of malaria convalescence stated that many cases initially considered to be falciparum later suffered relapses of vivax malaria. [16 p110] According to Alport, malaria occurs in its most severe forms in tropical and sub-tropical countries. Macedonia and West Africa were probably at the heart of this due to the fact that in these parts the Plasmodium falciparum parasite, the most virulent type, was extremely common. [19 p2]

### Prevention

The British army arrived in Salonica at the end of 1915, when malaria season was over. [14 p227] The first negative experience with malaria in Macedonia occurred in 1916, several months after the deployment of the troops on the frontline. For the first five months of 1916 there were only 50 cases of malaria. As the troops had not yet spent a summer in the country, and as malaria season had hardly started then, some of these cases must have been relapses of a previous infection contracted elsewhere. In June there were 90 cases, and of these 36 came from the Bitola (Monastir) area, while a much greater increase in the number of cases occurred in July, August, September, and October - the worst malaria months in Macedonia. [20 p85-86]

The great impact of malaria over the readiness of British soldiers for their combat activities on the front compelled the command structures to undertake preventative measures so as to halt its spread. Owen commented that preventative measures were initiated in three directions: 1. to protect the healthy soldiers from being bitten by mosquitoes; 2. to destroy mosquitoes as much as possible; and 3. to treat the chronic malaria patients carrying the germs in their blood, who would pass along the infection. [10 p289] The British military authorities created an organization that would fight against malaria and work on eliminating it, at the head of which was the Deputy Director of the medical services. The assistant directors of the medical services were responsible in their respective divisions. The divisional areas were divided into districts, with an officer who commanded a field ambulance. These officers appointed malaria medical officers from their units. It is interesting to note that there were special anti-malarial officers, responsible for drainage canalization and other treatment of water in their districts. [18 p33-34] The British military authorities also formed a special Malaria Enquiry Laboratory to ascertain the facts and to formulate the steps to be taken. Following its formation, there was a drainage of swamps, a clearing of streams, oiling and other methods to treat breeding places, fumigation and spraying, mosquito-proofing of huts, and quinine prophylaxis. [1 p284]

Following his first visit of Macedonia, Ronald Ross, a British medical doctor who received the Nobel Prize in 1902 for his work on the transmission of malaria, recommended the drainage of marshes along the Salonika – Bitola (Monastir) road. The British command appointed a team of malaria officers to take charge of this operation, and mosquito brigades commenced clearing streams and destroying larvae. [21 p440] Thus, in 1916 anti-mosquito measures were carried out in the areas west of Salonica along the Bitola (Monastir) road, while in 1917 the work was extended and it included almost all areas occupied by the British forces. In order to accomplish all of these acti-

vities, the British command organized anti-malaria squads in the base and communication areas, and in each corps area, a number of squads consisting of 26 men each were available to carry out anti-malaria work. Each battalion also had a squad of 21 men of all ranks. [19 p21] The duties of the anti-malaria squads included the treatment of breeding places in and around the camp, searching for and killing mosquitoes in huts, nets, tents. By the end of the War, according to Harrison, 479,999 yards (438,911 m) of new trenches had been cut to assist the process of drainage; 9,690 pools of water had been drained or filled in; 1,157,192 square yards (967,560 m<sup>2</sup>) of water had been oiled to kill mosquito larvae, and 363,315 square yards (303,777 m<sup>2</sup>) of brushwood had been cut to remove mosquito breeding places. [16 p115] New experiences were gained during the drainage of the terrain and the process of canalization. The drainage of Macedonian swamps, according to Alport, brought about satisfactory results. He proposed additional measures to combat and prevent the spread of malaria, such as that the places which could not be drained should be filled in with earth. He also suggested the adoption of other methods, such as the spread of paraffin over the pools. [19 p20] The first activities on the terrain, and the experiences gained from them, instigated some ideas as to how to proceed further. Willoughby and Cassidy believed that canalization and similar such activities should be commenced earlier in the year, in March or April. [18 p66] Macpherson, who was a medical service Director in the British army in Salonica, having gained some experience with vector control in Cuba, the Panama Canal, India and Palestine, noted: "This place will be unhealthy in summer and more so with tents. Mosquitoes will abound. Sir Ronald Ross, who was here, reported that we need have no fear of malaria for the next 5 months (April) and should take precautions in February." [22 p225] However, this advice by Ross was criticized by some British medical scientists. Sir Philip Manson Bahr, in his private notes concerning Ross, had written: "Then again in Nov. 1915 he was sent to Salonika to make a preliminary survey of malaria and the area to be occupied by the Expeditionary Force. He was accompanied by F. W. O'Connor. As the malaria season was at an end, he did not see any malaria but few anopheles. He never reached the Struma. He reported to the War Office that malaria in Salonika was not a menace. The result all the world now knows!" [23 p99] We suppose that his remark relates to the 1916 outbreak of malaria amongst the British troops.

History has shown that there have been times when military and other operations have had to be abandoned owing to the ravages of malaria. [18 p33] Consequently, one of the measures to prevent the spread of malaria was the removal of the troops from malaria-infested areas. Malaria delayed or halted combat operations and influenced the morale of the troops, producing a state of listlessness and apathy, known to the British as 'Balkan Tap.' [16 p108] Thus, the troops were to be withdrawn from the Struma valley so that they would not have to reside in low-malaria areas during the heat of the summer. The British command paid special attention to the manner in which the withdrawal was carried out in order to avoid any Bulgarian actions. [24 p4] Some of the medical officers proposed relocating the military camps to the hills since mosquitoes disliked windy conditions.

One of the most common preventative measure was the extermination of adult insects. Mosquitoes were mainly exterminated in large quantities in their larval stage, but malaria could be prevented by the systematic destruction of the adult insects. [18 p36] However, there were some problems that arose during this process. The burning and cutting of undergrowth were recommended, but it was a risky task on the frontline, with the enemy on the opposite side.

Another preventative measure against the spread of malaria and as protection against insect bites was to use mosquito-proof huts. For that purpose, British engineers had built mosquito-proof huts, consisting of wood, canvas and gauze, where the soldiers stayed when they were not on the front line. In 1918 a light form of mosquito-proof huts was set out on a large scale near the front line. The soldiers ate their meals there, or sat there in the evenings. [14 p245]

Sleeping nets were issued to increase the safety of the soldiers, with two soldiers sleeping under each net. Mosquito nets were seen as protection against the dreaded insects. [18 p54] It is interesting to cite the testimony of W. H. Sutcliffe on the importance of using mosquito nets to prevent the spread of malaria among the British soldiers – “during 1916 there was no mosquito net, the issue was one square yard a man. We were not allowed to demolish any of the cottages; they were wanted as billets during the cold winters. During 1917 there was an issue of proper mosquito net, and most of the troops were withdrawn during the summer months to the foothills...” [25 p248] The number of mosquito nets issued was not always adequate. Lake remarked that any protection was to be most carefully arranged, but due to the humid Macedonian summer nights, the soldiers slept restlessly and tossed off and destroyed their defenses. [5 p213] However, mistakes had been made, in all probability due to a lack of a sufficient number of nets. In early June, 1917, the 28<sup>th</sup> Division had to hand over 2,500 nets to the 10<sup>th</sup> and 27<sup>th</sup> Divisions because the latter were short of them. The consequence was an increase in the number of malaria-infected soldiers to alarming proportions. [9 p7] The fully soldiers understood the significance of the precautions and followed faithfully. General Milne reported that the mosquito nets were seen to be as important as weapons. [9 p7]

As a result, from their previous experiences, the British military authorities paid great attention to the personal protection of their military staff. Men on duty at night were provided with head nets and gloves. These were worn on all occasions except during patrols, raids, and larger operations where the nature of the duty rendered the use of these precautions impossible. Another precautionary measure introduced by the Military command was the whitewashing of the interior of the dugouts and huts. This is done as a matter of routine, so that the adult mosquitoes could be seen more easily and destroyed. [19 p21]

The usage of materials applied to the skin so as to repel mosquitoes was also recommended. Such materials were: crude paraffin, strong essential oils, tar preparations and Vermicelli. [18 p57] This yielded positive results as it kept the mosquitoes away from the soldiers for a couple of hours.

The education of the officers and soldiers from all the branches of the British troops stationed in Macedonia was also taken as a preventative measure against malaria. There were suggestions for practical demonstrations of larvae, as well as expla-



nations concerning the spread of the disease amongst the troops in the infested areas. [18 p57]

The British military authorities assessed the success of their anti-mosquito measures and concluded that if they were to be considered fully successful, the anopheles would disappear from the area. However, if they were still present, that would be proof that the measures had not been sufficient or properly carried out. [14 p244]

One of the most commonly used and applied methods in the prevention of malaria was the utilization of quinine prophylaxis in order to stop the further spread of this disease. Quinine prophylaxis had been recommended by Ronald Ross, who had served as consultant physician to the Mediterranean Expeditionary Force. Ross defined quinine prophylaxis as a treatment for those who had not yet shown signs of the illness, but may possibly have been infected. Treadgold, on the other hand, saw its administration as a way to prevent the development of clinical malaria. Actually, the Ross explanation suggested that quinine prophylaxis prevented new infections from occurring. [26 p16] The prophylactic dose of quinine was five to six grains a day, 10 grains two days per week, 20 to 30 grains a day were tried but few gave any encouraging results. [1 p284]

It was normal practice to see a daily quinine parade among the British soldiers in Macedonia. Every day the units would line up and march off to the doctor's headquarters. The men passed in single file and received five grains of quinine washed down with water. [5 p208] The practice of taking the daily dose of quinine was well described by Private Francis Ching: "You had to take quinine on the tongue, not as a tablet. You paraded for quinine once or twice a day. You went in front of the Sergeant Major who was in charge of the quinine powder. You'd put your tongue out, he'd have a little spoon and would dig into this can of quinine and place a small spoonful on the tip of your tongue. Then you'd be ordered to drink from your mug of water and swallow." [7 p335]

However, there was uncertainty about the effectiveness of quinine prophylaxis. Most of the medical officers in Macedonia were disillusioned with quinine as a preventative measure. General Whitehead reported in 1916 that the results of quinine prophylaxis had been disappointing. [21 p441] Regarding the use of quinine prophylaxis, Alport held the same belief about its effectiveness as a preventive measure in dealing with malaria. It had been extensively tested in the Salonika area and had proved to be an absolute failure. [19 p17] Treadgold also thought that the available evidence indicated that in Macedonia, at any rate, the disadvantages of quinine prophylaxis outweighed the advantages. [27 p528] The British medical officers in Salonika felt that quinine prophylaxis did not work as they had expected, and some of them believed that it had failed due to the fact that the troops disliked it as a result of its bitter taste. Nonetheless, quinine prophylaxis was not abandoned and some of the officers argued that not using it would make the situation even worse.

Another measure that was undertaken by the British military command to stop or slow down the spread of malaria was the evacuation of the infected and sick soldiers to Britain and Malta. In December 1917, the famous medical scientist Ronald Ross visited Salonika for the second time during the War. On February 15, 1917, Ross was appointed to the War Office as Malaria Consultant. [23 p85] His mission was to set up a

so-called Y-scheme for the selection and evacuation of men infected with malaria. It is interesting to note that this plan was to remain secret in order to hide the severe health conditions of the British troops in Macedonia from the British public. [22 p230] The Y-scheme was brought into operation, with which a huge number of malaria-infected soldiers were sent home.

Wenyon emphasized that the Y-scheme did not only reduce the number of cases by the removal of the most heavily infected individuals, thus undoubtedly preventing each of these men from going to hospital several times, but also removed the worst carriers, who would have been responsible for the infection of a vast number of mosquitoes. In all, over 25,000 men were sent back, and it can hardly be an exaggeration to suppose that during the summer and autumn these men, had they remained in Macedonia, would have contributed to 50 to 60 thousand admissions to hospital. [20 p92] Concerning the number of evacuated soldiers, we encounter more data. Owen stressed that from January to October 1918, nearly 30,000 soldiers were sent home. [10 p188]

There are interesting assessments about the success of the preventative measures against the occurrence and spread of malaria undertaken by the British military authorities on the Macedonian front. Most of these measures, according to Brabin, were introduced effectively too late partly due to disagreements concerning prioritization. [26 p9] Falls was of the opinion that had it from the first been possible to decide that in Macedonia protection from malaria was, after food and ammunition, the very first necessity, it would be reasonable to suppose that the British Salonica expedition forces might have been at a higher standard of strength and efficiency, that a certain number of lives might have been saved, and that many thousands of men might have been spared ill health after the War. [24 p288] Owen noted that the protection of the healthy soldiers was carried out in every possible way by means of nets, mosquito-proof huts and dugouts, special shorts, gloves and head nets, unfortunately seldom appealing to the user. [10 p280] Hamilton concluded that in a country like Macedonia, especially around Salonica, it was absolutely impossible, due to the front line “to thoroughly carry out all preventative measures against malaria. War has its price. Those who wage it in malarious climes must remember that, in spite of the most rigid precautions against disease, the cost must be a heavy one.” [17 p369] However, Goodall had a more realistic approach concerning the results of the measures taken by the British military. He felt that the greatest experience of the preventative measures was derived from the activities in Macedonia, and that these were applicable to all stages where war was being waged, and could be classified as: drug prophylaxis and treatment, mosquito deterrents, personal protection, or mosquito destruction. [13 p13]

## Conclusion

The British military and medical personnel stationed on the Macedonian Front encountered unprecedented conditions. British military experts and physicians swiftly determined that the army was positioned in one of the most perilous regions, characterized by high prevalence of malaria. Drawing on experience from the preceding

period, their initial investigations focused on the geography and climate of the region. The experts, very soon, recognized, beyond treating infected soldiers, the paramount aspect in combating malaria was its prevention.

The prevention strategy against the spread and infection of malaria was channelled into three main directions. First, to protect healthy soldiers from mosquito bites; second, to eliminate mosquitoes as much as possible; and third, to treat chronic malaria patients carrying the infectious germs in their blood, thereby preventing further transmission. One of the initial measures undertaken in the malaria prevention campaign involved draining the swamps in areas where British military units were deployed, coupled with relocating them to more secure positions. Another measure involved the eradication of adult's insects. One of strategy aimed at impeding the spread of malaria and protecting against insect bites was the utilization of mosquito – proof huts. A widely employed method in malaria prevention was the application of quinine prophylaxis to halt the disease's further dissemination. This approach had been advocated by Ronald Ross, who served as a consultant physician to the Mediterranean Expeditionary Force. Nevertheless, there was uncertainty regarding the efficacy of quinine prophylaxis, leading to disillusionment among most medical officers in Macedonia. To curb or slow down the malaria spread, the British military command implemented the evacuation of infected and ill soldiers to Britain and Malta. The Y-scheme was activated, facilitating the repatriation of a significant number of malaria infected soldiers. The comprehensive experience gained from preventive measures in Macedonia indicated their applicability to all stages of warfare and could be categorized into drug prophylaxis and treatment, mosquito deterrents, personal protection and mosquito destruction.

## Rezime

Britansko vojno i medicinsko osoblje stacionirano na Solunskom frontu naišlo je na do tada neviđene uslove. Britanski vojni stručnjaci i lekari brzo su utvrdili da je vojska pozicionirana u jednom od epidemiološki najopasnijih regiona, koji karakteriše velika rasprostranjenost malarije. Oslanjajući se na iskustvo iz prethodnog perioda, njihova početna istraživanja su se fokusirala na geografiju i klimu regiona. Stručnjaci su vrlo brzo prepoznali da je, pored lečenja zaraženih vojnika, najvažniji aspekt u borbi protiv malarije njena prevencija. Strategija prevencije širenja i zaraze malarije kanalisana je u tri glavna pravca. Prvo, zaštita zdravih vojnika od ujeda komaraca; drugo, eliminacija komaraca u najvećoj mogućoj meri; i treće, lečenje pacijenata sa hroničnom malarijom koji nose infektivne klice u svojoj krvi, čime se sprečava dalje prenošenje. Jedna od početnih mera preduzetih u kampanji prevencije malarije uključivala je isušivanje močvara u oblastima gde su bile raspoređene britanske vojne jedinice, zajedno sa njihovim premeštanjem na sigurnije položaje. Druga mera uključivala je iskorenjivanje odraslih insekata. Jedna od strategija usmerenih na sprečavanje širenja malarije i zaštitu od ujeda insekata bila je upotreba koliba nepropusnih za komarce. Metoda koja se široko koristila u prevenciji malarije bila je primena profilakse kininom da bi se zaustavilo dalje širenje bolesti. Ovaj pristup je zastupao Ronald Ros, koji

je služio kao lekar konsultant u Mediteranskim ekspedicionim snagama. Ipak, postojala je nesigurnost u pogledu efikasnosti profilakse kininom, što je dovelo do razočaranja većine medicinskih službenika u Makedoniji. Da bi obuzdala ili usporila širenje malarije, britanska vojna komanda sprovela je evakuaciju zaraženih i bolesnih vojnika u Britaniju i Maltu. Aktivirana je Y-šema, olakšavajući repatrijaciju značajnog broja vojnika zaraženih malarijom. Sveobuhvatno iskustvo stečeno preventivnim merama u Makedoniji ukazalo je na njihovu primenljivost u svim fazama ratovanja i moglo bi se svrstati u profilaksu i lečenje drogama, sredstva za odvracanje komaraca, ličnu zaštitu i uništavanje komaraca.

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