

CHAPTER X

SUMMER IN THE JORDAN VALLEY

THE interval of comparative quiet preceding the final offensive in Palestine was spent by the Desert Mounted Corps in the Jordan Valley. The conditions were depressing in the extreme, but the period was chiefly remarkable for the intense campaign against malaria, the greatest effort in prevention of disease undertaken by the medical service in Palestine.

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The conditions under which the Australian light horsemen lived during their periods of duty in the Jordan Valley were the most trying that they experienced at any time in the campaign. Three factors made for great discomfort, namely, heat, dust, and mosquitoes: in the last was contained also a menace to health, fraught with the gravest possibilities. This was malaria. In the British military *Handbook to Palestine and Syria* it was stated that no European had passed a summer in the Jordan Valley. Though this was hardly correct—since a settlement of Greek monks had lived near Jericho for many years—the unenviable reputation earned by the valley for malaria and heat was not unmerited.

The actual information available as to the climate when, at the beginning of summer, the Desert Mounted Corps took over control of this area was meagre. It was said that all natives able to do so left Jericho and its neighbourhood during the summer months: but this migration was probably more on account of malaria than of the heat *per se*. The southern end of the Jordan Valley was known to be hottest, the heat

increasing with the depth below sea level, which at Rujm el Bahr, at the head of the Dead Sea, is 1,280 feet. Here, it was stated, the maximum shade temperature might reach 122 degrees Fahrenheit, while at Kasr Hajla (two miles north of the Dead Sea) the mean maximum shade temperature in summer was said to be 110 degrees.

Either the summer of 1918 was less severe than usual or, more probably, previous observations were inaccurate. In

The heat

May the Anzac Field Laboratory was established one and a half miles north-west of Jericho at the foot of the hills,¹ and here, from the end of May till the beginning of November, exact daily records were kept.² The highest shade temperature actually recorded was 114 degrees on June 14th. On only four other days did it reach 110 degrees, and the total number of days on which it rose to 100 degrees or higher was eighty-eight. The graph, however, shows the high average maximum and mean dry-bulb shade temperatures.³ The highest wet-bulb temperature recorded was 83 degrees, and it remained constantly on a high level: the registrations at 8 a.m. averaged from 70 to 78 degrees, at 2 p.m. from 72.5 to 78.5, and at 8 p.m. from 69 to 74.5. Records of sun temperature are not available but are remembered to have been very high. Readings taken at Rujm el Bahr during August showed dry-bulb temperatures two to four degrees lower, wet-bulb ten degrees higher, reaching 88 degrees and rarely falling below 80 between 8 a.m. and 8 p.m. Readings at Ghoraniyeh bridge-head differed little from those at the laboratory, and at corps headquarters at Meshrab, 1,700 feet above the Dead Sea, were only five degrees lower. The heat in the sun under which the troops

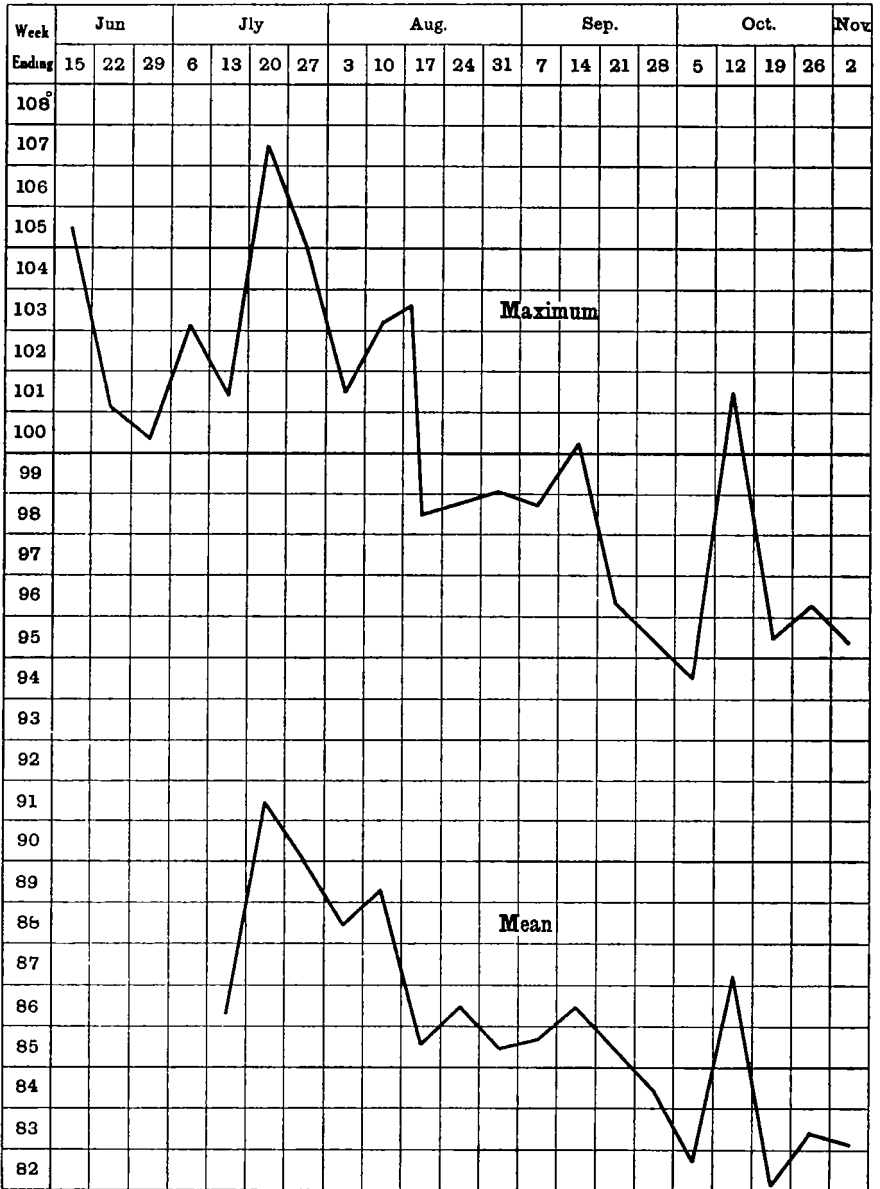
¹ At this time three field laboratories were working in Palestine, the Anzac near Jericho, No. 3 Military Laboratory at Jerusalem, and No. 2 at Ludd. There were also six "malarial diagnosis stations" at work. The personnel of each such station consisted of a specially trained medical officer, and two orderlies, who were also trained in malarial diagnosis. The essential equipment consisted of two microscopes and the necessary technical material, particularly stains. A general service waggon with four horses was provided for their movement. They were employed as near to the forward troops as possible.

² True shade temperatures were recorded, a standard shade-box being used and thermometers checked by psychrometer.

³ The mean dry-bulb temperatures on the Mesopotamia lines of communication for the same months were 80, 92, 97, 96, 88, 75, 68 degrees. The average daily maximum for July was 122.2 degrees F.

Graph No. 12

AVERAGE WEEKLY MAXIMUM AND MEAN SHADE TEMPERATURE



carried on their duties of patrolling, digging, wiring, caring for their horses, anti-mosquito work, and the like was naturally much greater. Shelter consisted chiefly of bivouacs which barely allowed sitting up; in the few bell tents the temperature at times reached 125 degrees. Even in the fine Indian pattern tents, which were largely in use by the divisional receiving stations when stationary, one and a half degrees higher than true shade was registered. Only the mud and stone huts erected at the end of summer for the receiving station showed a temperature lower than true shade—some four and a half degrees.

The direct effects of heat were inconspicuous. The question of providing heat exhaustion stations was considered in the early summer, but the necessity for their establishment never arose. In the higher parts of the Jordan Valley the mitigating

**Its
direct
effects
slight**



The Jordan Valley, showing depths below sea level

effect of even slight air movement was felt in a post-meridian breeze. But without doubt freedom from direct heat effects such as those experienced in Sinai were due to the large supply of pure and cool water for drinking and washing.⁴ The indirect effects, however, of the climate were undoubtedly great. The "extremely depressing effects" were variously attributed to "humidity," "pressure effect," "stillness of the air," and "high temperature at night." With the exception of the second, each of these probably contributed to the debility clearly manifested by troops after a period in the valley.

But even more trying than the heat, and perhaps a debilitating factor, was the dust. It would be difficult to

Dust and depression

picture a more dusty atmosphere than that in which the troops in the Jordan Valley lived.

The dust was of a light powdery nature and very irritating. On the stillest of days a single horseman would raise a cloud that completely obscured him and was slow in settling. On most days a breeze blew in the valley, and the pall of dust, plainly visible from Jerusalem twenty miles distant, had from the hills the appearance of a bank of fog through which little or none of the country could be seen.⁵

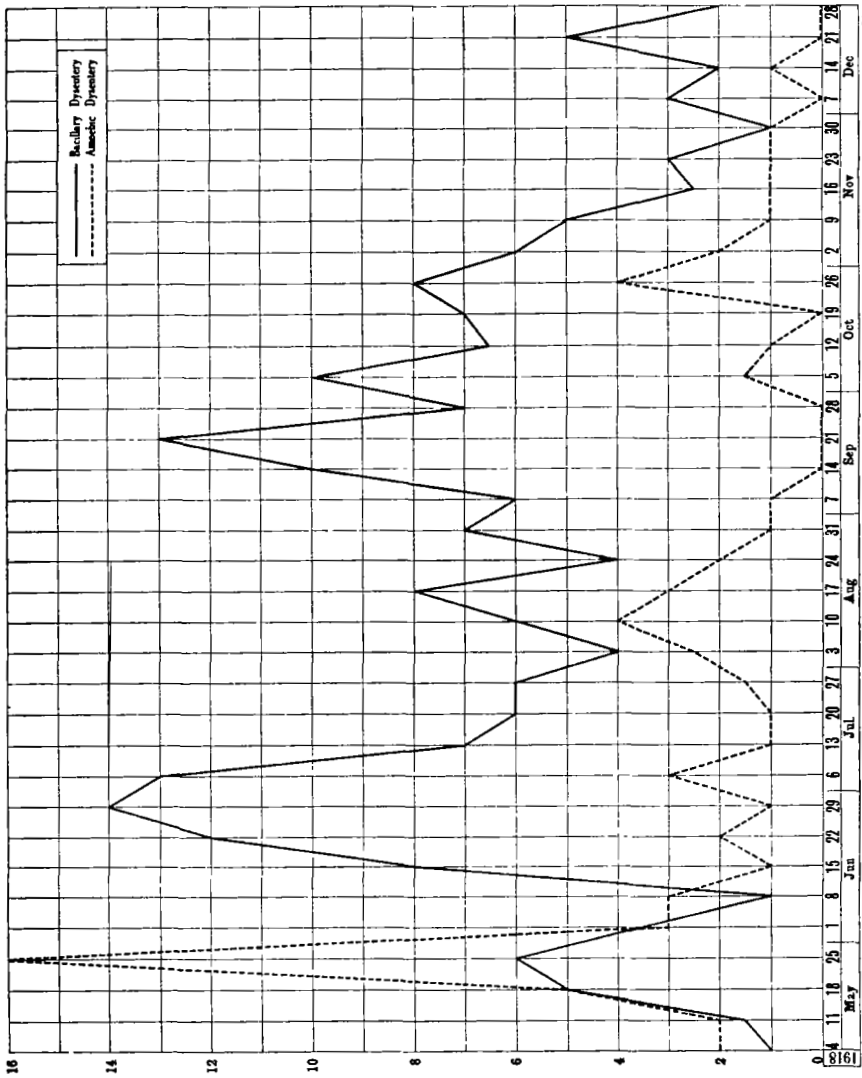
The food and feeding during this period did not help to mitigate these physical drawbacks. Meat, for the most part,

⁴ "Thirst" (it was noticed) "in the Jordan Valley hardly ceases, and fluid is consumed in very large quantities. One gallon daily is a low average amount. Egyptians required one gallon per head at Roman, two in the Jordan Valley. Sweat secretion is tremendously stimulated . . . fluidity of kidney and bowel excretions markedly diminishes." See, as a contrast to experiences here, the serious effects recorded in *pp.* 571-2 and 600-1.

⁵ It was far from being the light horsemen's first experience of dust. In the early months of 1915 they had grown used to the violent dust storms known as the *khamsens*, during which the stinging particles of sand pervaded everything, and any kind of work was almost impossible. These, however, lasted but three days at most. The sand was clean and easily got rid of, and, apart from sand colic, did little harm. In 1916 a few of these storms were encountered in the Sinai Desert under conditions of greater heat and with almost an entire lack of shelter from sun and sand. In 1917 the dust in which the light horsemen lived while stationed along the Wady Ghuzze was very bad, being powdery in nature and present practically all the time. It seemed irritating, and was thought to be responsible for slight intestinal disease and to a certain extent for the epidemic of septic sores. But none of these experiences was equal to the Jordan Valley dust. Any body of troops after a short march on a regular track presented a ludicrous appearance suggestive of pierrots, and individuals were often quite unrecognisable. On one occasion the writer, while travelling slowly in a motor car, met another car in a head-on collision without the driver of either car having caught a glimpse of the other until after the impact.

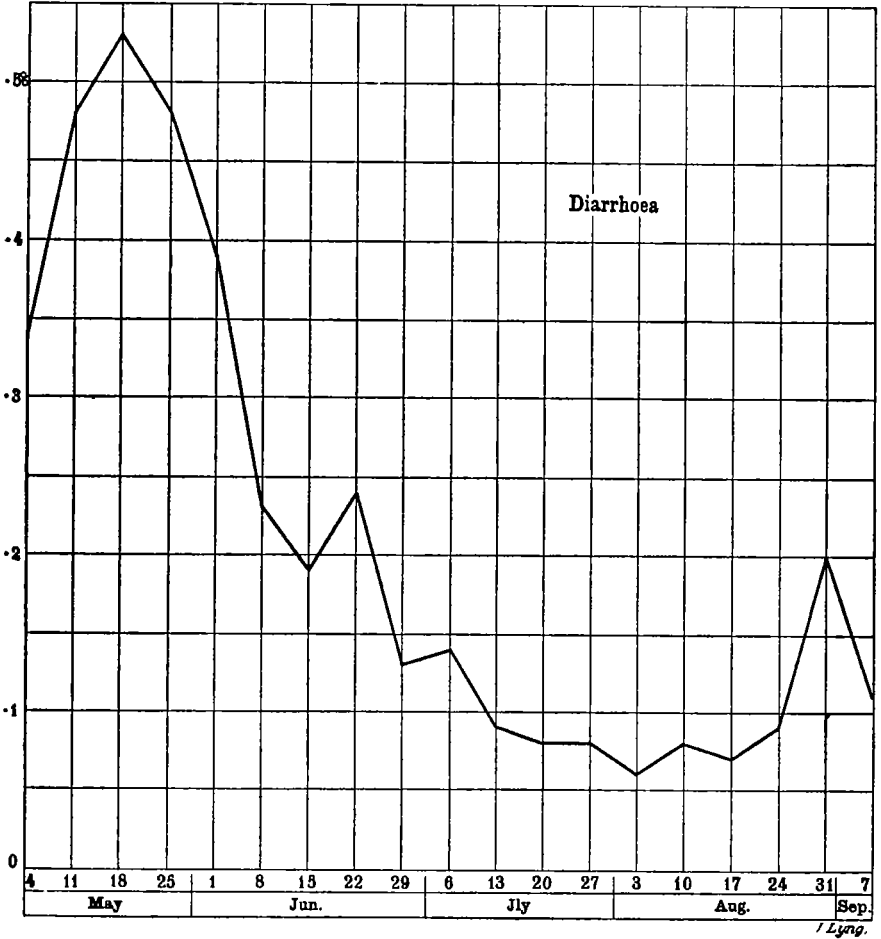
Graph No. 13

WEEKLY RATE PER 10,000 OF STRENGTH, OF MEN EVACUATED FROM THE
DESERT MOUNTED CORPS WITH DYSENTERY . MAY TO DECEMBER 1918



Graph No. 14

WEEKLY RATE PER CENT OF STRENGTH, OF MEN EVACUATED FROM THE
DESERT MOUNTED CORPS WITH DIARRHOEA : MAY TO SEPTEMBER 1918



was "bully beef"; the bread was dry before it reached the troops; fresh vegetables were scarce. The depression of spirits and generally careworn appearance of the troops living under these conditions, apart from actual ill-health, was very noticeable at this time. Shortage of sleep—the soldier's chief hardship—was here much intensified by the heat and mosquitoes, and no doubt it was largely this, together with the cumulative effects of the hardships of the two previous years, that caused the general depression.

But the feature of the Jordan Valley—as of Palestine in general—which during the summer had the greatest influence of all upon the situation in respect of health was the endemic prevalence of malaria. All other factors were of comparatively minor significance. A certain amount of dysentery occurred, and a few cases of enteric. Relapsing fever, typhus, and smallpox were seen; sand-fly fever was not very uncommon. But by this time the sanitary situation was well in hand. The two Australian and two British sanitary sections, long since well-organised and highly efficient, relieved each other in the Jordan Valley. Sanitary discipline was good. Incineration was the recognised method of disposal of excreta; fly-breeding and louse-infestation were under control. Scabies was not in Palestine a serious problem. The incidence of naso-pharyngeal and inspiratory infections was not exceptional; that of non-transmissible disease was not excessive for two years of heavy strain and physical drawbacks and was in large measure amenable to the various steps taken to promote rest and recuperation. But from May onwards an increasing and ultimately heavy wastage was brought about by infection with the parasite of malaria—both *Plasmodium vivax* (benign tertian) and *Plasmodium falciparum* (malignant tertian), with a small incidence of quartan—in spite of determined, well-organised, and scientifically controlled measures of prevention.

Indeed, the greatest problem faced by the medical services in the whole campaign was that of the prevention of malaria during the summer of 1918. In 1916, as has been noted, a small number of men had contracted the disease at the

transport camp alongside the Sweet-water Canal at Kantara.⁶ In the following year the mosquito-breeding pools of the Wady Ghuzze were a more fruitful source of infection, and continual efforts were needed to render them innocuous. In 1918, however, the menace of malaria to the health and strength of the army became very great and called forth vast efforts to hold it in check. All Palestine and Syria are infested with malaria-bearing mosquitoes, particularly in the low-lying country of the Jordan Valley, and little less in the wadis and swamps of the coastal plain. More than one Crusade appears to have been brought to an end by malaria, and the losses occasioned by it are stated by some writers to have been a factor in the failure of Napoleon's expedition into Syria. Under the general direction of the D.M.S., E.E.F., and with the expert advice of Major E. E. Austen, some of the most important and extensive anti-malarial work done in the war was carried out in the Jordan Valley; the immediate direction was by the medical services of the Desert Mounted Corps. The actual details of preventive work in the control of mosquito-breeding were carried out, under the supervision of the administrative officers of corps and divisions and of the sanitary sections, by troops of all arms, supplemented by the Egyptian Labour Corps. Every man in the force was made to feel some personal responsibility in the fight against the pest.

Based on the life-cycle of the malarial parasite, evolved in the æon-long association of mosquito and man, wherein the female of various mosquitoes—notably of the genus *Anopheles*—acts as the "definitive" host for the sexual stage of the parasite, and man as the "intermediary" host for the asexual stage, which is completed in his blood, there are four obvious lines along which action may be taken to prevent transmission of the disease. The first is the removal of the

⁶ It may be recalled that this area of Egypt was at one time heavily infested with malaria, and was one of the first in which was illustrated the epochal nature of the discovery of the *Plasmodium malariae* and the demonstration of its life-cycle in the mosquito. It may also be remembered that, in the practical measures which to a great extent stamped out the disease in Egypt, Sir William MacGregor, at one time Governor of Queensland and of Papua, and himself a graduate in medicine, took an important part.

infected persons. As the disease was widespread throughout Palestine, this would have involved the deportation of the whole population within the area occupied by the troops.⁷ Considerable numbers of Indian and British troops from Macedonia were also carriers. Search was not made

Removal of infected impossible

for these; but all acute cases diagnosed were evacuated and effectively treated. It was, however, considered impracticable to combat epidemic malaria by removing the primary source of infection. A second line of defence is by preventing the bite of the mosquito. As far as possible, this

Precautions against bite

was done, mosquito-nets to fit inside the bivouac being issued to every man. It was found, however, in the Desert Mounted Corps that close supervision was necessary to ensure their proper use. In some units it was thoroughly carried out, and disciplinary action was taken against any man who did not cover himself properly when sleeping. In other units mosquito-nets were looked on as effeminate and unsoldierly, and little supervision was exercised. A repellent cream was issued, but proved of little or no value. Gloves and veils were issued to a few units for the use of men on patrol at night; the gloves were useful, but the veils interfered too much with vision. Third, there is the possibility of prophylactic

Quinine prophylaxis

treatment, which aims at the destruction of the malarial parasite in the blood, by means of quinine or other drug previously and regularly administered to the exposed individual. This was not generally carried out.⁸ Lastly, measures for the prevention of mosquito-breeding may be carried out within the area concerned, and this was the line along which the greatest efforts were made in the Desert Mounted Corps.

Prevention of breeding

⁷ An examination of the children in Jericho showed that enlargement of the spleen—almost definite evidence of malarial infection—was present in 60 per cent.

⁸ The value of this defensive method was (and is) much debated. To obtain information on the question, it was tried in two light horse regiments, the 9th and 11th. In one squadron in each regiment every man was given five grains of quinine daily by mouth from May 15 to Aug. 24, the remainder of the regiments having none. During this period ten cases of malaria occurred in the treated squadrons, eighty in the untreated—a ratio (allowing for difference in strength) of one case in the treated troops to 2.3 in the untreated. (See Part III of this Volume in connection with this method of prophylaxis.)

It was not till May that more than a few scattered cases of malaria occurred, the first alarm being given when several men of the Camel Corps who had been evacuated to Ludd after the first trans-Jordan raid were reported suffering from malaria. Two months earlier detailed instructions had been issued as to the measures to be taken both for the prevention and for the treatment of the disease, but little had actually been done. From this time until the corps left the area, operations against the larvæ of *Anopheles maculipennis*, *Anopheles palestinensis*, and *Anopheles turkhudi*—the species found most commonly in the Jordan Valley, and all known to be malarial vectors—were prosecuted with increasing vigour, as it was over the whole British front. The conditions in connection with mosquito-breeding vary considerably in the three zones into which Palestine naturally falls. In the coastal region (XXI Corps area) breeding was heavy along the Nahr Auja and its tributaries and in swamps. In the Judæan Hills (XX Corps) anophelene breeding, though considerable, was not excessive, the water-supply being chiefly from wells and cisterns more favoured by other varieties of mosquito.⁹ The Jordan Valley was much the worst; indeed the area immediately fronting the Turkish positions, and of very considerable extent, was described by Major E. E. Austen as “by far the worst I have ever seen either in Palestine or Macedonia.” Here the breeding grounds occupied in all a very extensive area, and to deal effectively with it so as to control breeding was a huge undertaking and demanded exact organisation, close supervision, and the continuous labour of large numbers of men.

Before the beginning of the malarial season, in supplement of the sanitary sections there had been appointed in each brigade a “Brigade Malarial Officer,”¹⁰ who trained anti-malarial squads (of from six to thirteen) in each regiment. The first step taken was the location by these squads of all actual or potential breeding-places: by combining the

⁹ *Anopheles bifurcatus* was, however, found in cisterns all the year round.

¹⁰ Provision made for the training of medical officers in all the aspects of malarial prevention, diagnosis, and treatment has been mentioned in previous chapters.

reports of different squads a complete mosquito survey of each divisional area was made and a map compiled. A copy of this map, showing the situation in his area, was given to the A.D.M.S. of each division when it entered that area. This survey, and the subsequent inspection and control of the execution of the anti-mosquito measures decided upon, were supervised by the D.A.D.M.S. of the division, who made frequent reports for corps headquarters and was in turn overlooked by the D.A.D.M.S., Desert Mounted Corps. Finally, expert advice was given by Major Austen, who inspected and reported to the D.M.S., E.E.F., on all mosquito-breeding areas within the army zone. Wherever possible, the direct performance of the work was handed over to an engineer officer. The large number of men required was provided chiefly from the divisions in the form of working parties, but these were for a time supplemented by 1,000 native labourers from the Egyptian Labour Corps in areas unlikely to be shelled. As the anti-mosquito work carried out by the troops was additional to the daily task of trench-digging, wiring, and the care of horses it encroached gravely on their already meagre rest, and at first working parties were, not unnaturally, supplied with some unwillingness; but after personal inspection of the worst areas the Commander-in-Chief ordered that anti-mosquito operations were to take precedence of all duties except protection.

A mosquito survey undertaken

And a vigorous campaign

In view of the thoroughness with which these anti-malarial operations were carried out under service conditions immediately in front of an active enemy, an account in some detail may be of use. The anopheles mosquito breeds chiefly in still but fairly clear waters, especially those in which weeds and algæ are growing. The essence therefore of anti-mosquito work was the elimination of all such stagnant collections of water of whatever size, or, failing this, to cover the surface with a thin coating of oil, whereby the mosquito larvæ are denied access to the air and rapidly die. The collections of water demanding attention were contained, first, in the wadys which, rising among the Judæan hills, enter the Jordan after traversing the five to seven miles of its alluvial valley occupied by the troops. In the northernmost part of this area were the Wadys Auja and Obeideh, the latter a seasonal, the former a good-sized perennial

The breeding grounds

stream; into the former flows the Wady Mellahah, which, commencing behind the enemy lines, was joined by several tributaries traversing the valley on the Turkish side. The course of these and other streams that enter the Jordan have the same general character in respect of mosquito-breeding. Down the eastern slopes of the Judean range the streams run in several rocky gorges some hundreds of feet deep and in parts almost inaccessible. Entering the flat Jordan plain, some become in summer a succession of pools, which come to a gradual end among the undergrowth. The banks of all are irregular and undefined, and are overhung with vegetation; the pools are choked with reeds, and work among these in the damp heat was extremely exhausting. Just inside the British wire close to the Wady Mellahah was a marshy tract, several acres in extent, covered with low scrub and intersected by small streams and full of pools of water. From this marsh the small wady flowed to the Auja, often blocked with dense beds of grassy weed. This area was described by Major Austen in his report as "a most dangerous and pestilential spot, in which a species of *Anopheles turkhudi*, a known carrier of sub-tertian malaria, is breeding in myriads." In the neighbourhood of Jericho are two important springs, the Ain es Sultan and Ain ed Duk; from the former an abundant supply of water flowed into two reservoirs, from which irrigation channels ran through dense undergrowth, to be broken down into numerous minor channels where mosquito-breeding was intense. From the Ain ed Duk flows the Wady Nueiameh, a perennial stream led by aqueduct round the foot of Gebel Kuruntul (the Mount of Temptation). The banks of this wady, much used for irrigation, are overhanging and covered with vegetation, while algæ along the edges gave cover for myriads of mosquito larvæ. It was also used for watering horses, and even in the small pools forming in hoof holes mosquito larvæ would be found in swarms. East of the Jordan, within the Auja and Ghoraniyeh bridge-heads, were large swamps, while further south, near the Dead Sea, was the most difficult area of all to deal with—a swamp round the mouth of the Wady Rameh covered with dense jungle, chiefly bamboo. Other swamps of varying size, some with dense vegetation, lay along the Jordan Valley. In every collection of fresh water intense mosquito-breeding was

**Clearing,
canalisation,
and draining**

found. The methods of dealing with these breeding-places were as follows. In all areas an endeavour was made to expose the whole of the water-course as fully as possible by cutting down and clearing the vegetation so as to make a path on either bank of the stream. In some places, such as the upper part of the Wady Nueiameh, this was extremely difficult and was only carried out by burning. The next step was canalisation, the object of which was to confine the water in a channel as narrow as possible and with steep sides so as to prevent stagnation and maintain a rapid flow. This was carried out by making banks of stones placed in line and backed with puddled clay. Side-channels were closed. By these means many shallow ill-defined channels from 10 to 12 feet broad were converted into defined deep drains from 3 to 5 feet across, crossings being made where required. Many miles of this canalisation



102. THE AUSTRALIAN MOUNTED DIVISION'S SANITARY SECTION
PASSING ALONG THE WADY NIMREN

An enemy machine-gun opened fire on the section near the spot shown,
causing nine casualties out of a strength of nineteen

*Lieut. by Major Harry Sutton - I F M C
Aust. War Memorial Collection No. B2714*



103. ONE OF THE DRAINS FROM THE SWAMPS AT HAJLA IN THE
JORDAN VALLEY

Aust. War Memorial Official Photo No. B-27

To face p. 719



104. HOSPITAL WARDS OF STONE AND MUD IN COURSE OF CONSTRUCTION
AT THE ANZAC MOUNTED DIVISION RECEIVING STATION NEAR JERICHO,
JULY 1918

*Lent by Major A. M. Allen, 1st Fld. Sqd. Enns.
Aust. War Memorial Collection No. B2528*



105. CANALISATION IN THE JORDAN VALLEY SWAMPS

*Lent by Major Harold Sutton, I.A.M.C.
Aust. War Memorial Collection No. A2238*

To face p. 711

were carried out. As the volume of water diminished, the channels were narrowed. Sometimes channels only 6 to 9 inches wide were left, in which case oil drip-cans were placed on wooden supports at the source and oil was delivered at the rate of 20 drops per minute. Constant patrolling and attention were required to keep these canals in order, the smallest break being quickly followed by mosquito-breeding. The method of dealing with the three principal swamps mentioned was by drainage, in the planning of which considerable ingenuity was required. The principle adopted was to make one central drain with subsidiary channels and to remove all vegetation along their banks, and thus maintain a free flow of water. When the flow had stopped, the channels were filled in. In this way large swamps were completely dried up. When these methods were inapplicable, oiling was carried out, a mixture of equal parts of heavy oil and kerosene being used. In a few cases pools were pumped dry and filled in. To secure effective results, whatever the method adopted, constant supervision was necessary, for example, to deal with the growth of algæ, which was very rapid and provided excellent cover for breeding, as well as protecting the larvæ from the small fish which feed on them.

The question whether, and if so to what extent, these vast labours had commensurate result in lessening the incidence of malaria is one to which unfortunately an exact answer—that is to say, one which may be expressed in figures—cannot be given. For this the chief reason is that the troops left the area at the time when the most extensive outbreak—that of malignant tertian—was due to occur.¹¹ Moreover the heavy incidence of this form subsequently experienced and the great sick wastage which accompanied it were associated with factors that complicate the epidemiological problem. Of these, and of the subsequent history of malaria in the light horse, an account appears later, together with details of the diagnostic work carried out in the laboratories.¹² Here it may be stated that there was a steady rise in the number of cases (almost all of the benign type of tertian) up to the middle of July, followed by a fall to the end of August. In September the curve rose slightly till the time of the opening of the final offensive. At no time during this period did the evacuation from malaria exceed 1.5 per cent per week of the total strength of the corps.

¹¹ The seasonal rise of benign tertian precedes that of malignant tertian in Palestine by about a month.

¹² A graph, showing the incidence of malaria in the Desert Mounted Corps, is given at p. 750.

The total wastage from all sickness during this period is shown in the following table for the Anzac Mounted Division, which may be taken to represent sufficiently accurately the proportion for the Desert Mounted Corps.¹⁸

1918.	Average weekly sick rate per cent.	
	Admitted to Fld. Ams.	Evacuated from Fld. Ams.
January95	.61
February70	.53
March83	.76
April	1.85	1.71
May	1.94	1.83
June	2.38	2 14
July	4.19	3.98
August	3.06	2.91
Up to 14th September ..	3.08	2.52

Besides the specific steps mentioned above to prevent disease, no effort was spared to minimise the time during which the troops should be exposed to the conditions in the Jordan Valley, and to promote their general health. The plan adopted on the military side was to hold the valley lightly, and thus give each of the four divisions in turn only a short tour of duty—from four to six weeks. On relief a division was sent either to the comparatively bracing climate of Bethlehem and the Pools of Solomon south of it in the Judæan Hills, or to the less bracing but cooler coastal area. As the result of experience of the good effects of the rest stations on the beach at Tel el Marakeb in 1917, an "Ambulance Rest Station" for the corps was established in the grounds of a monastery at Jerusalem. This was staffed by the personnel of the immobile sections of different ambulances in turn. A good supply of tents and mattresses was obtained, extras in the way of food provided, and the troops put under conditions differing as much as possible from the ordinary regimental life. Valuable help was given by the Australian Red Cross Society in the supply of games,

¹⁸ The other three divisions of the corps were in process of reorganisation, so that comparable figures are not available. See also Graph No. 16 at p. 744.

amusements, and comforts. The men sent to this rest station, including Indian cavalymen, were those run down or debilitated after minor sickness. The results achieved illustrate the great importance of efforts along these lines in the prevention of sick wastage in an army. The system of leave to the Australian Rest Camp at Port Said had been stopped during the Palestine offensive: this was reopened at the beginning of January, 1918, and throughout the period spent in the Jordan Valley quotas averaging some 350 men were sent there every ten days. This allowed seven days clear rest, under very satisfactory conditions.

The sick Australian trooper evacuated to the base during this period of the war in the East was received, for treatment, convalescence, and return to duty, into a medical system which was highly organised and very efficient: and though the proportion of the force "constantly in hospital" had by this time reached a high figure—in some measure an index of the increasing wear and tear of the war—the moment for which the toils of the past two years had led up found the Australian formations satisfactorily at strength and the troops themselves, though war-worn, physically fit to rise to a great occasion.