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REPORT ON THE PREVALENCE OF MEDITERRANEAN FEVER AMONGST BRITISH TROOPS IN MALTA, 1905.

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INTRODUCTORY.

On taking up the investigation of Mediterranean fever in its epidemiological aspects, at the beginning of June, 1905, after consideration of the various lines on which such an enquiry might be best carried out, I became convinced that the most profitable course to adopt would be to devote the greater part of the time at my disposal to the study of the disease as it manifested itself amongst the British troops. Dr. R. W. Johnstone having made a general survey of the circumstances in regard to the whole population, civil, naval and military, up to the time of writing in the previous year, it seemed that a more detailed consideration of one branch of the
subject—even though in numerical importance only a small one—might lead to useful results. I was the more inclined to take this course for two reasons: first, Dr. Johnstone had made such a comprehensive survey of the "sanitary circumstances and prevalence of Mediterranean fever" in the previous year, that there was no need for another enquirer to go over the same ground a few months later; and, secondly, the fact that, in regard to the military population, the statistical data—which are the foundations of an epidemiological enquiry—are to be relied on almost implicitly; while in regard to the population of Malta generally, our knowledge of the actual distribution of the disease, both in place and time, is at present so very imperfect, that the difficulties in the way of discovering the causative factors are extreme. Dr. Johnstone has mentioned this in his Report. The notification of Mediterranean fever throughout the population generally is extremely inaccurate, "only severe cases are notified, and not always these." Now, whether in regard to differences of prevalence in different places, or variation in incidence at different times, unless there is good ground for trusting to the accuracy of the records of prevalence (i.e., the notifications), the labour expended on enquiring into apparent outbreaks may be entirely thrown away.

The military population concerned is approximately 9,000; if every case of Mediterranean fever occurring in this population during even a single season were accurately recorded as to time and place of onset, and as to all the surrounding circumstances that could be regarded as bearing on the problem, a body of facts ought to be forthcoming that would at any rate make some addition to our knowledge of the causation of the disease; if not of the actual cause, at least of the conditions favouring the effectual operation of the cause. There seemed to be every likelihood, from the behaviour of the epidemic in May, that a large number of cases would occur amongst the troops during the hot season; and that the amount of material for investigation would be large enough to make it justifiable to limit the enquiry to this particular line. From January 1st until September 30th, 1905, there occurred 487 admissions for Mediterranean fever from among the British troops, and it is to the study of this epidemic that I have chiefly given attention.

Three principal lines of investigation presented themselves: (1) It appeared to be necessary to make a detailed sanitary survey of the actual conditions under which the troops are living in the various barracks in the Maltese Command: I accordingly visited
repeatedly every individual barrack and examined into its situation, construction, water supply and drainage, as well as any other matters that seemed to need investigation. In the present state of our knowledge, or want of knowledge, as to the causation of Mediterranean fever, it did not seem allowable to neglect any point of general sanitary importance, even though its connection with the prevalence of this disease did not seem to be obvious. It does not, however, appear necessary to encumber this report with all the detailed results of this investigation, referring in many instances to somewhat minute points of sanitary engineering practice or military administrative procedure; a brief summary only of the more important points is set forth in Section I., the details forming a separate Report presented to the Director-General, Army Medical Services.

(2) Concurrently with this the course of the epidemic was noted, and as far as possible enquired into at the time, and on the spot, week by week; the intention being to record, as accurately as might be, the actual incidence of the disease in the various barracks and in the various regiments. As far as I have been able to ascertain, it has hitherto been the practice to allocate the cases of Mediterranean fever to the barracks from which they have been admitted; the object of this part of the special enquiry has been to trace the origin of these cases with greater exactness, ascertaining the movements of the patient previous to admission to hospital, and endeavouring to locate not merely the barrack, but the room, which he had been occupying for some time before admission. In this way it was hoped that some facts would be ascertained that would serve as indications as to the cause, or rather the mode of spread, of the disease. These results are summarised in Section II. of this Report.

(3) As another means to the same end, the attempt was made to interview personally every Mediterranean fever patient, and elicit all the information procurable as to his habits, occupations and so on, previous to being taken ill. Unfortunately, some patients were too ill to be questioned, some were invalided before I was able to visit them; so that, from one cause or another, not more than 187 were actually interviewed. I much regret that I was not able to carry this part of the enquiry further.

The information obtained by these three lines of enquiry is summarised in Section III., in which an attempt is made to correlate the various facts, and ascertain what relation exists, if any, between Mediterranean fever prevalence and this or that
sanitary condition. The conclusions arrived at, and certain recommendations submitted, are set down in Section IV.

**Incubation Period.**—A great difficulty, that has been experienced by all enquirers into the epidemiology of Mediterranean fever, arises from the uncertainty that exists as to the length of the incubation period. Hughes, from his own experience and from a study of the literature of the subject up to the time of writing (1897), considered that it might be "as short as three days in some cases. Probably three to ten or fifteen days is near the mark in cases where the first febrile onset is noted." Dr. Johnstone states that "the general impression amongst Maltese medical men seems to be that the usual incubation period is not more than eight or ten days." In five laboratory cases of human infection "in places where there was no prevalence of Mediterranean fever, and no apparent source of infection other than in relation with infective material in the laboratory," the periods were respectively five, six, eight, fifteen and sixteen days. These infections appear to have all been by inoculation; all were accidental, except the one with sixteen days' incubation, which was definite and purposeful. In the previous Reports of the Commission instances are recorded of infection by inoculation manifesting itself after five and eight days in monkeys (Gilmour), after six days in goats (Shaw), after six, ten and thirteen days in monkeys (Horrocks); in all these cases the agglutination test has been taken as the proof of infection. By the same test infection by feeding has been demonstrated in monkeys after about twenty-four to thirty-two days in several cases (Horrocks), and in one case, in a goat, apparently after twenty-one days (Horrocks). There is a sufficient agreement in these results to lead to the supposition (which is on other grounds reasonable) that with infection by inoculation the incubation period is shorter than by ingestion into the alimentary canal; with inhalation of infected dust (monkeys) the incubation period is uncertain, seventeen to thirty-one days, or less (Horrocks).

How far the period of incubation observed in animal experiments can be considered to hold good in the case of man is doubtful; the doses used in the laboratory have been enormous; and as it would be unreasonable to suppose that the quantitative element has no effect on the rapidity of development of the disease, the laboratory limits, in all probability, require to be considerably extended when the question of human infection in the ordinary way or ways has to be dealt with. As we are at present ignorant of the path of infection in man, we must assume that incubation may be as short
as about a week, and may be as long as about five weeks, according as the infection is by inoculation or by feeding. But considering the very much smaller doses of pathogenic material likely to be actually absorbed than those used experimentally in the laboratory, it seems probable that not less than a fortnight should be regarded as a minimum period, and that the maximum period should be extended up to about six weeks at least.

In the absence of any more definite guidance I have adopted a fortnight as the most likely incubation period at the least, and a further fortnight as probably needful to be allowed for incubation. That is to say, if a man moves from Barrack A to Barrack B, and subsequently develops Mediterranean fever, I consider that if his illness commences within a fortnight of his change of residence, the infection was almost certainly contracted at A; while if it commences within a month of the move it has more probably been contracted at A than at B. I have not been able to ascertain any shorter instances of incubation than the two quoted by Dr. Johnstone (Report, Part II., p. 15), of eight and eleven days respectively; and the behaviour of the epidemic in the Essex Regiment (detailed in Section II.) points to about five weeks as probably the longest usual interval between infection and onset of illness. Further observations are much needed in regard to this matter.

Diagnosis.—All cases admitted to the military hospitals in Malta, that have been returned as Mediterranean fever, have been diagnosed as such, both by their clinical features and by the results of the agglutination test; this has been invariably applied, and no case has been returned as Mediterranean fever unless the reaction has been definite and complete.

SECTION I.

The most important points in regard to the sanitary condition of the barracks in Malta may be shortly summarised under the general headings of situation, construction, water supply and drainage.

In Valletta itself, and Floriana, there are seven separate barracks, all more or less antiquated in their plan and construction.

In Lower St. Elmo an infantry battalion (2nd Essex Regiment until July, 1905, then 1st Lancashire Fusiliers) is accommodated in a part of the fortress that occupies the extremity of the promontory separating Marsamuscetto or Quarantine Harbour from the Grand Harbour.
The fort adjoins the sea on two sides, but, being excavated in the rock, the barracks are entirely deprived of any advantage from this proximity; while on the south they adjoin the most densely inhabited part of the city, and on the east are shut in by the more elevated part of the fort, called Upper St. Elmo. The barrack-rooms, 52 feet in length, are casemates arranged in two tiers, and are very imperfectly ventilated: they accommodate twenty-three men in each, and the cubic space is barely 600 feet per head. The drinking water supply is ample; a second quality of water is provided for ablution, not always in quite sufficient quantity; sea water is laid on for flushing purposes. The latrines are water-closets of good pattern, and have recently been fitted with new automatic-flushing apparatus; the urinals are of the ordinary type, having a scanty flush of water, and being also treated with a coating of kerosene oil. The drainage has been remodelled in recent years, and is satisfactory; the soil pipes are ventilated, and accessible inspection chambers provided at junctions of the underground drains, which discharge into the Civil Government sewer.

The water supply and drainage arrangements of these barracks are in the main satisfactory; their construction is very insanitary, the ventilation bad, and the cubic space insufficient. Although it is the practice in Malta generally to issue tentage during the summer months, sufficient to allow of 25 per cent. of the troops sleeping out of the barrack-rooms, since June, 1903, Lower St. Elmo has been excepted from this privilege, for reasons which I have not been able to ascertain. These barracks are, in my opinion, more in need of this thinning-out process than any others in the whole island. The accessories are fairly satisfactory, except that one of the cook-houses adjoins a stable.

Upper St. Elmo adjoins the last-mentioned on the east, is at a higher level, and is in every way more advantageously situated, being freely exposed either to the sea or the harbour on three sides. The barracks are occupied by two companies of the Royal Garrison Artillery; but, the quarters being insufficient for their accommodation, many of the men live and sleep in tents. A lower portion, consisting of two tiers of small casemate rooms, is occupied by 96th Company Royal Garrison Artillery; the rooms, being only about 25 feet long, are not difficult to ventilate, but the cubic space allowed (440 to 536 cubic feet per head) is very small. The upper portion consists of rooms of more modern construction, and not of casemate shape; but the cubic space, about 550 cubic
feet per head, cannot be considered as sufficient. The water supply is satisfactory. The latrines are not satisfactory; the lower latrine, used by 96th Company, has recently been fitted with an automatic flush, but it is in a dark and cramped situation; the upper latrine, used by 65th Company, was in a bad state at the time of my visit, the flushing arrangement being completely out of order, and the pans full of excreta. The urinals are scantily flushed; oil has not been taken into use. The drains are generally in a satisfactory condition, accessible inspection chambers being provided where required; some points of detail need attention in regard to the drainage of the new sergeants' mess.

The barracks generally are better than Lower St. Elmo; but the continual use of tents in this very confined situation must lead to fouling of the ground.

St. James Cavalier is a small barrack, accommodating a detachment of 138 men belonging to the Royal Garrison Artillery stationed in Upper St. Elmo, at present 65th Company. It is situated in the upper part of Valletta, the barrack-rooms being casemates similar to those in Lower St. Elmo; two of the rooms are 51 feet in length, with most inadequate openings for ventilation; they are, however, authorised to accommodate thirty-two men in each, giving a cubic space of only 535 feet per head, which is quite insufficient; four other rooms are not so long, and therefore not so hard to ventilate; all the six rooms are authorised to hold more men than there is actually space to accommodate, unless the bed-cots are arranged in three rows, a practice which would be most insanitary, and is universally condemned. At least 750 cubic feet should be allowed per head; and, even with this increase, it is doubtful if No. 6 room would be reasonably fit for occupation. The drinking water supply is satisfactory, also that for ablution; but for latrine flushing it has had to be carried up by hand. Throughout the greater part of the past summer all the water supply for the latrine has had to be carried up by hand, as a company fatigue, the result being that a minimum quantity has been provided, and the condition of the latrine has been insanitary. It is absolutely necessary that water should be laid on to a latrine in a permanent barrack. With this exception the drainage arrangements are satisfactory. The situation is bad, and the construction of the barracks insanitary.

Floriana Barracks, including Salvatore Counter Guard and Notre Dame Ravelin, are occupied by a battalion of infantry, at present the 1st Royal West Kent Regiment. They are situated
on the the north side of Floriana, and within the outer line of the landward defences of Valletta, of which they form a part. The old portion of these barracks consists of a range of twelve casemate rooms, about 80 feet in length, each accommodating thirty men, with an allowance of from 700 to 1,203 cubic feet per head. In casemates of this length, with no window openings except at the two ends, it is impossible to secure proper ventilation. At present the barracks are not crowded, as the accommodation is sufficient for 920, and the battalion does not number more than 780. A peculiarity of these barracks lies in the circumstance that the Malta Civil General Hospital occupies the upper part of a building, on the ground floor of which are the regimental offices, stores, &c. There is no communication between the ground and upper floors, and the drainage of the hospital is quite distinct from that of the barracks, but it is most undesirable that such a building, into which infectious cases (e.g., possibly cholera or plague-stricken sailors) might be admitted, should form part of a structure occupied as a British barrack.

The New Barracks consists of three blocks of two-storey buildings, each accommodating one company, that have only recently been completed; the rooms are well arranged, according to modern principles, each holding twenty-six men, with an allowance of 755 cubic feet per head.

The rooms in Salvatore Counter Guard are small casemates with no through ventilation at all, and with a scarp wall distant only 12 yards from the front of the rooms; the movement of air must be very limited at any time, and adequate ventilation impossible; in spite of this, the allowance of cubic space is less than 600 feet per head; neither have the men been thinned out at night during the hot weather.

Notre Dame Ravelin consists of a range of sixteen small rooms on the ground floor, accommodating five men in each, with an allowance of 900 cubic feet per head; and of seven huts, each for eighteen men, with 600 cubic feet per head. These are all well ventilated and of satisfactory construction. The huts stand on a concrete platform and are slightly raised from the ground.

There is a good supply of No. 1 water for drinking and No. 2 water for ablution purposes; for flushing the supply (No. 2) is sometimes defective in the Old Barracks; a larger tank and separate supply for the latrine seem to be required. The drainage of all these barracks is of modern construction and, in the main, satisfactory. One of the latrines in the New Barracks was in bad order.
at the time of my visit, partly owing to a structural defect; and in several places the internal surface of the drains is uneven, leading to obstruction, or retardation of flow; gully gratings are in some places deficient. The urinals are treated with oil, and also flushed with water.

Of these barracks it may be said that the New Blocks and Notre Dame Ravelin are satisfactory, but that the Old Barracks and Salvatore Counter Guard are bad and incapable of being made suitable for accommodating troops. Great complaints are made of the extensive fouling of the ground in the neighbourhood of these barracks, where a large number of Maltese labourers are employed road-making, &c. The troops have no control over these people, and the civil authorities appear to be powerless in the matter.

St. Francis Barracks, Floriana, are a small range of barracks of very old type, partly on one, partly in two stories, occupied by a company of Royal Engineers. Nos. 3 and 4 rooms on the ground floor are large apartments, 66 by 29 feet, authorised to accommodate forty-five men in each; the ceiling is arched, and, if the height be reckoned as 26 feet, the cubic space per head amounts to 1,079 cubic feet, as shown in the Barrack Return; but if 12 feet of height only be reckoned (according to the general rules for calculating cubic space), the amount per head is only 500 feet. The means of ventilation are insufficient. Nos. 6 and 7 are large rooms on the upper floor, fairly well provided with windows and ventilating openings, but difficult to ventilate, on account of their excessive width—40 feet. These are very unsatisfactory barracks; if they are to continue to be occupied, a cubic space of 750 feet should be allowed, and no greater height than 12 feet should be reckoned as available for ventilation purposes. The water supply is satisfactory. The latrine and urinal are of a very old pattern, and require reconstruction; the drainage is modern and in good order.

Marsamuscetto Barracks, occupied by the Army Ordnance Corps, consist of two rooms on the ground floor, each accommodating forty-one men; the rooms are arched casemates, 72 feet in length, having windows only at one end: adequate ventilation is impossible, yet the effective cubic space (reckoning a height of 12 feet) is only 540 feet per head. The number of actual occupants is at present less than half the allotted number, so that there is no overcrowding; but the building is unsatisfactory. The latrine is within 20 feet of the cook-house; it is flushed only twice a day; a third flush at least is required. The urinal is intermittently and scantily flushed with water. The drainage is in good order.
The **Old Laboratory Barracks**, occupied by Army Service Corps, Army Pay Corps, Military Foot Police and Garrison Staff, consist of four rooms at an upper level, and two at a lower level; the upper ones are arched casemates, with very inadequate ventilation; the lower ones are in a very cramped and confined situation. The latrine is exceedingly cramped, dark, and ill-ventilated. The barracks are said to be condemned. They are incapable of being made really satisfactory from a sanitary point of view. The water supply and drainage are inadequate.

**Manoel Fort and Hutments** together accommodate an infantry battalion; up to the beginning of June they were occupied by the 1st Rifle Brigade, since then by two companies of the Lancashire Fusiliers. The situation, on a small island in Marsamuscetto Harbour, is favourable, with free air-space all round. Seven of the barrack-rooms in the fort are casemates, about 32 feet in length, each accommodating nine men, with 600 cubic feet per head; being small rooms, their ventilation would not be unsatisfactory, but that the blank wall of the chapel and officers' quarters is only a few feet distant from the front of the rooms, and materially interferes with the free passage of air. Three other rooms, accommodating thirty-six men in all, are free from this disadvantage. The hutments consist of twenty-eight huts, each accommodating eighteen men; they are well raised from the ground on pillars; the surface beneath is cemented, clean and dry, and they are not overcrowded. The water supply is satisfactory; No. 1 water is used for drinking and washing in the hutments; in the fort, No. 2 water is collected in tanks in the rainy season, and used for ablution and flushing purposes. The latrines are all on the dry earth system; a double set of buckets is provided, but the excreta are removed only once a day, in the early morning. The water drainage system takes urine and ablution water, and discharges direct into Marsamuscetto Harbour; it is of modern construction and satisfactory. Except for the retention of the dry earth system, these barracks are in a good sanitary condition. A connection should be made with the Civil Government sewer as soon as possible.

**Tigne Barracks**, occupied by three companies of Royal Garrison Artillery, consist of the old fort, two new blocks of quarters, and fifteen huts; in addition are married quarters, offices, institutes, &c., all of modern construction. The situation is excellent, having the open sea to the north and east, and Marsamuscetto Harbour to the south. The fort contains only a few small rooms; one on the upper floor is well ventilated; seven on the ground floor are at a lower
level surrounded by the fort wall, and badly ventilated; only two are in present occupation, and all (it is said) will be evacuated shortly. The two new blocks, each accommodating 100 men, are two stories in height, and satisfactory in every way; except that the urine tubs have to be carried through the rooms on the upper floor from the verandah at back to the staircase in front, thereby leading to fouling of the floor with possibly infective material. The huts accommodate eighteen men in each, are well raised off the ground, which is concreted and easily kept clean, and are not overcrowded. In the summer 25 per cent. of the men sleep in tents; in the 99th Company no trestles or bed-boards were supplied, and the men's mattresses were placed on the ground; this should not be allowed.

At present, No. 1 water is used for all purposes, 20 gallons per head being allowed for everything. Until recently the latrines were on the dry earth system; now that a water latrine has been erected, it will probably be necessary to draw on the rain-water tank beneath the barrack square; but it would be better to lay on a supply of flushing water. In the fort the ablation water and urinals drain into a system that eventually enters the open sea; a dry earth latrine remains in use, which is regrettable. For the rest of the barracks an excellent modern drainage system has just been completed, discharging into the Civil Government sewer. Two dry earth latrines still remain in the western part of the barracks, one being for the use of the school; the other is no longer required; this should be closed, and a water latrine provided for school use. A large new latrine has just been opened to the north-east of the barrack square, containing thirty-four seats; this is flushed three times daily, at present with No. 1 water. It is an important question affecting several barracks, whether this No. 1 water, the supply of which is very limited, should be used for flushing purposes. There is great danger of the quantity being restricted, leading to an offensive and insanitary condition of the latrines; it is also very doubtful whether its use for this purpose is justifiable under the circumstances obtaining in Malta. I am very strongly of opinion that a supply of flushing water should be laid on to all latrines, and used in great abundance; and that No. 1 water should only be used (as a rule) for drinking and cooking purposes. In the present case the greatest care should be taken to prevent this new latrine, connected with a new system of drainage, from degenerating into the filthy and dangerous state that so many of the latrines in Malta have been allowed to get into, principally
through deficiency of a proper supply of water, in some instances unavoidable, in other instances the result of neglect.

The urinals are treated with paraffin oil and lampblack, and water flushing is used as well. The new urinal contains twenty-six stalls, the authorised allowance (4 per cent.) for the number of troops occupying the barracks. It is extremely inconvenient to collect all the urinals together in one place; and when so many stalls are provided in one range most of them are not used; not more than six or eight stalls are ever required in one range; the rest are useless, and lead to a great waste of water.

Except for the minor points of detail, these barracks are satisfactory in every way as regards situation, construction, water supply, and drainage; but care must be taken in regard to the matter just mentioned, in order to maintain this satisfactory condition; if water is stinted for flushing purposes, the state of things will be very different.

To the south-east of the Grand Harbour, and elevated a considerable height above the sea-level, lie the Verdala Barracks, a chain of fortifications called the Cottonera Lines, and at the harbour's mouth Fort Ricasoli.

Verdala Barracks, occupied by an infantry battalion (2nd Hants), consists of sixty-six small casemate rooms, each about 25 feet in length, and accommodating ten men; they are disposed on two floors and in two rows; being small rooms, and in a fairly airy situation, their ventilation presents little difficulty; the cubic space allowed is, however, only 515 feet per head, which is not sufficient; the accoutrement shelves are fixed to the walls in a continuous line, and the bed-cots are only 12 inches apart from each other. Drinking water is laid on, and the supply is ample; for washing No. 2 water is pumped up by regimental fatigue; until July, 1905, all the water required for flushing purposes was also similarly pumped up; now, however, salt water is laid on for this purpose, but the supply at the time of my visits was uncertain, and frequently No. 2 water had to be pumped up, regimentally, as before. The regimental latrine is situated rather near the cook-house; it is of Jennings' continuous pipe pattern, and until recently was only flushed twice a day; it is now flushed three times daily, at 9.0, 2.0 and 5.0, and this is hardly sufficient. When a proper supply of salt water for flushing is available, it should be done four times a day. The urinal has fourteen stalls, aggregated together, many of them being never used; both water flushing and oil application have been practised, the former ineffectually; the stone
floor is very uneven and requires putting in order. The underground drainage is modern and, on the whole, satisfactory. Some additional ventilation to the system would be advisable, and provision for automatic flushing instead of the present inefficient method of flushing by hand with barrels of salt water when it is available. The sanitation of these barracks has been well looked after, under circumstances of considerable difficulty.

The quarters which together make up the *Cottonera Lines* are St. Clement's Bastion, Zeitun Gate, Polverista, St. John's and St. Paul's Bastions, Couvre Porte, Vittoriosa, Fort Salvatore, Zabbar Gate and Notre Dame; accommodating in all about 780 men, that is, an infantry battalion. In the early part of 1905 they were occupied by the Royal Sussex, and then by the Lancashire Fusiliers; since the departure of this regiment for Lower St. Elmo they have been mostly vacant, except for detachments of the Hants Regiment in Polverista and St. Clement's. All of the barracks are old and defective in many ways; proper ventilation is very difficult; if their occupation is continued, at least 750 cubic feet per head should be allowed, reckoning only a height of 12 feet as of any value for ventilation purposes. The small rooms at Zeitun Gate are fairly sanitary, but the larger ones, Nos. 5, 6 and 7, measuring about 32 by 20 feet, without any windows except in the front wall, are impossible to ventilate satisfactorily. The rooms in Polverista, which are arched casemates, 33 feet long, accommodating fourteen men in each, are also very inadequately ventilated. The small rooms in St. John's and St. Paul's, although inconvenient, are not difficult to ventilate. At Couvre Porte, No. 11 room has no window at all, and is unfit for occupation. Vittoriosa has three large rooms, each accommodating thirty-four men, which are airy and well lighted, though a proper cross ventilation is not possible. The three large rooms at Fort Salvatore, each measuring about 80 by 20 feet, cannot be adequately ventilated by the very small openings that at present exist. At Zabbar Gate the two large rooms, though light and airy in appearance, are very hard to ventilate, on account of their great width—36 feet. Notre Dame, consisting of eight small rooms, is fairly satisfactory.

The water supply of these small barracks is a matter of some difficulty, and in connection with the latrine arrangements requires more attention than has hitherto been given to it. No. 1 water for drinking is laid on, and is sufficient and always available. For washing purposes and for flushing latrines and drains No. 2
(collected rain-water) has, until last July, had to be pumped up by regimental fatigues; at Polverista the pump has broken down several times (twice during the time I was making my visits to the barracks in July and August); the labour of working this pump appears to be excessive. I was informed that a fatigue of nine men, working six hours a day, was required. On three occasions I found the latrine empty of water, but fouled with excreta; this appeared to be a not uncommon occurrence. It has been the same with the other outlying barracks. Salt-water flushing is in course of being provided, but so far the supply has been uncertain. Until an ample supply of water is available for adequately flushing the latrines—at least three times a day—and for keeping the extensive system of drains in good order, these barracks are not fit for occupation.

The drainage generally is modern and satisfactory in construction. There has been considerable complaint of bad smells in front of Polverista; the drains are properly constructed, but more water is required for flushing the verandah drain and down pipe leading into the collecting drain below.

Fort Ricasoli lies at the mouth of the Grand Harbour, on its eastern side, in an ideal situation; it is open to the Mediterranean and the harbour in three directions, and has the open country to the east, with no villages near. An ample supply of drinking water is laid on, used also for ablution purposes, and salt water is drawn from the sea for drain flushing, by a pump independent of any other supply. The drainage passes direct into the sea, by three independent systems of drains, which have been laid down within the last few years according to modern principles, and which are in good order. Some additional provision of fresh air inlets would, in my opinion, be desirable. The latrines and urinals are well kept, a mixture of tar and kerosene oil being used for the latter. One latrine was found to be without any water (but full of excreta) on one occasion, owing (so I was informed) to choking of the branch supply pipe. Even under the quite exceptionally favourable conditions as regards water supply at Ricasoli, strict supervision and watchfulness are necessary.

The barrack-rooms are mostly large and lofty, having plenty of window space on one side (facing the square), but no openings on the other (which is the outside of the fort); five such rooms are each over 100 feet in length by 22 feet wide, accommodating between fifty and sixty men in each. Being about 23 feet in height, the cubic space per head (about 1,100 feet) is large, but it is not
all available for ventilation purposes, not more than 12 feet of height being really effective; on account of this height and the width of the rooms, it is difficult to get a free change of air. The bed-cots are placed very close together. No. 1 room, 80 by 22 feet, has two windows only on one side, and a doorway at one end; there are no windows on the other side or at the far end, which is quite unventilated.

The actual barrack accommodation is for 480; but three companies Royal Garrison Artillery are normally stationed here, with a strength of about 700; about 120 are quartered in outlying forts, and about 150 in tents pitched in the barrack square, occupied all the year round. In the summer 25 per cent. extra tent accommodation is drawn. Although the construction of the barracks is not sanitarily satisfactory, the general good hygienic conditions of Ricasoli, and its fine airy situation, should make it a healthy station.

Outlying forts on the eastern side: Small bodies of men are accommodated in several small forts in this direction. In every case the cubic space is sufficient, though, from military exigencies, ventilation is restricted. Drinking-water is laid on to all the forts; but for some months during the past summer this pipe supply has been cut off, and the water has been carried out to the fort in barrels. The drainage arrangements are generally satisfactory, as regards slop water and urine. Dry earth latrines are in use. These require to be more carefully supervised, and the removal should be more frequent.

The barracks hitherto mentioned have been, in the main, old buildings, dating from a pre-sanitary era, though added to from time to time, and with drainage and water supply modernised more or less efficiently. On the north side of the island are two extensive ranges of barracks, one of which, St. George’s, was built in 1860, and has since been added to, and the other, St. Andrew’s, has only been completed in the year 1905. Each of these accommodates an infantry battalion.

St. George’s Barracks, occupied by the Royal Dublin Fusiliers, consist principally of single-storey blocks of small barrack-rooms, accommodating thirteen men in each, with 605 cubic feet per head; these are of good construction, and very fairly well ventilated; the accoutrement shelves are fixed to the walls in a continuous line, and the bed-cots are only 12 inches apart from each other, which causes what may be called an artificial overcrowding at night. There are two new double-storey blocks of quite modern design, airy, well ventilated and well arranged; the rooms accommodate
sixteen or eighteen men in each, with an allowance of 750 cubic feet per head. A defect in the arrangements is that the urine tubs have to be carried through the rooms on the upper floor, from the back to the front (as at Tigne), thereby leading to fouling of the floor with urine, which is most undesirable.

No. 1 water is laid on for drinking and also for washing, the supply being quite ample; it is also laid on to the married quarters for flushing purposes as well. In the barracks sea water is pumped up for latrine and drain flushing, but owing to defects in the pumping arrangements, the quantity of water provided has been insufficient, and the latrines have not been properly cared for. The drainage is of modern construction throughout and is well looked after; the latrines are flushed three times a day if water is available; the urinals are in good order, a mixture of lampblack and kerosene being applied. There are several minor defects which might be easily rectified. One frequent source of drain obstruction in Malta is the readiness with which sand and gravel are blown into and washed into and through gullies; in these barracks, which are well exposed to the wind, this occurs to a considerable extent, and causes some difficulty in keeping the drains clear; raised parapets, to keep out surface washings, and deep traps might be supplied in some places with advantage.

St. Andrew's Barracks were only completed in the early part of 1905, and were taken over by the 1st Battalion Rifle Brigade in June. They consist of nine double-storied company blocks, the rooms accommodating fourteen men in each, with a cubic space of 800 feet per head. They are satisfactory in every detail, except for the necessity of carrying urine tubs through the rooms on the upper floors. The water supply is No. 1 for all purposes. The drainage is satisfactory in its main features, but there are several points of detail that require attention, such as the provision of accessible manhole covers (instead of cemented slabs), easing off of right-angled junctions, &c.

Pembroke Camp is a musketry camp near St. Andrew's Barracks, occupied by parties of men from various regiments in succession throughout the whole year, as many as 800 or 900 being sometimes under canvas at once. Its sanitary condition is very unsatisfactory. The ground is rocky and uneven, and difficult to keep clean; the sites of the tents are never, or hardly ever, changed. There is one dry earth latrine of twenty-six seats for the whole camp; this is not sufficient accommodation for the numbers that are frequently present; the latrine seats are badly constructed, being too high (or
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the pails placed too low); fouling of the ground with urine results. The pails are removed only once a day, between 4 and 5 a.m., the result being that for the greater part of the twenty-four hours the air of the camp is fouled by excretal emanations; flies are also attracted in great numbers. The woodwork of the latrine is in bad repair. The urinal consists of a plain marble slab like a native convenience; it is flushed with water and no oil has been applied. At the north-west end of the camp is a cesspit, connected with the officers' w.c., apparently unventilated, and in close proximity to the water tank and officers' cook-house. A water drainage system is now being carried out, and this cesspit should be removed.

Pembroke Camp is in a very bad sanitary state, not due to any want of care on the part of the camp authorities, but on account of obvious defects of design and construction in what may be called minor details. A small permanent sanitary staff should be provided to keep the camp in as sanitary a condition as may be possible, and lessen the difficulties resulting from the constantly shifting character of the population.

In regard to the outlying forts in the Western District the same remarks apply as to those in the Eastern, except that No. 1 water is laid on in each case, and is ample in quantity. The dry earth system is in use, and is fairly satisfactory, except at Maddalen, where the accommodation is insufficient, there being only two latrine seats. Everywhere removal only takes place once a day, which is not enough. A modern drainage system for slop water, &c., has been laid down in each case.

Imtarfa Barracks consist of four large blocks, accommodating 233 in each, and four smaller blocks, accommodating 110 in each, all of two stories; the rooms are constructed for either sixteen, eighteen, or twenty men, with a space of 750 cubic feet per head. They are excellent barrack-rooms in every way, well built, and with every convenience. No. 1 water is laid on for drinking and washing; rain-water is collected in underground tanks, and pumped up regimentally for cleaning and flushing purposes. The latrines have hitherto been on the dry earth system, but a water carriage system will be introduced very shortly. A complete system of drainage has been constructed, to which the latrines can be readily connected up. The dry earth latrines were in a satisfactory condition at the times of my visits, but I was informed that this had not been the case earlier in the summer, and that it had been found necessary to employ regimental fatigues to apply the dry earth thoroughly. It is difficult to get the dry earth system properly
carried out anywhere (though principally a matter of regimental discipline), but the difficulty is much increased in the case of a body of men who have been accustomed to the use of water latrines, that require no attention on the part of the individual. In the present case a rather considerable prevalence of enteric fever has been due, in all probability, to faulty carrying out of the dry earth method at Imtarfa. The latrines are emptied by contract once only in the twenty-four hours, about 2 a.m.; during the greater part of the day, therefore, they are full of excreta, and the air of the barracks proportionately fouled. Flies are quite a plague in some parts of the lines, a fact which is always significant and generally of ill omen. The urinals are treated with a mixture of colza oil and tar; this has acted most satisfactorily, applied once a week. The urinals here were in a better state than any others in Malta at the times of my visits. The underground drainage system is satisfactory on the whole; at one or two places the fall appeared to be hardly sufficient, e.g., at the north-west corner of the canteen a considerable amount of deposit was found; there was also a good deal of deposit in the main collecting drain at the east end of the barracks, north of the junction with No. 1 cook-house drain; in both places this has, I understand, occurred before, more than once. Additional flushing is required, and careful supervision to see that no stoppage takes place.

Some surface drains which take the washings of the verandahs of married quarters lead into the foul drainage system, passing through a gully trap to cut off the foul air. Such is the case in M, N, O, and P Blocks, Married Quarters. But the verandahs of these blocks are not habitually, and probably very seldom, if ever, washed down with water; consequently, in dry weather no water gets into this gully, or at least not enough to provide an efficient seal. The trap was unsealed at the time of my visit, in the case of each of the above-mentioned blocks, the trap being almost dry, and choked with sand, which at the bottom was moist and foul-smelling. These traps require to be seen to, and filled with water periodically. The sewage is at present conveyed to a kind of septic tank, the effluent from which is applied to land in the Kleir Wied, to the north of the barracks. This method of disposal is quite inoffensive.

The situation of these barracks is all that could be desired. They stand on an isolated hill, some 600 feet above the sea, exposed to the fresh air on all sides, and with no insanitary dwellings near at hand. The barracks are well constructed and sanitary. With
a good water supply, and a proper system of sewerage and refuse removal, the troops should be free from all epidemic disease. It has, however, unhappily been the case that there has been a good deal of sickness this past year, due to preventable causes.

At Ghain Tuffieha and Mellieha, in the extreme west of the island, are camps used by the troops, chiefly during the winter season; also at Ghain Tuffieha is the standing camp of the Mounted Infantry, the permanent strength of which averages 250 to 300 men throughout the year. The situation of each of these camps is quite satisfactory. In each case there is a good and ample supply of drinking water laid on; also a drainage system on modern principles. At Mellieha the latrines are water latrines, and the whole of the drainage is conducted to a small septic tank, the effluent from which passes into the open sea. At Ghain Tuffieha, up to the present, the dry earth system has been in use. The drains carry off drainage from cook-house, stables, urinals, &c., to a septic tank, hermetically sealed up with great care, the effluent from which passes into the sea. When water latrines have been provided, in place of the dry earth buckets, and connected with the existing drains, this camp ought to be extremely healthy, provided the ordinary rules of camp sanitation are strictly carried out, and the drains carefully looked after.

Fort Chambray, Gozo, is an old fortress of the Knights, in which there is accommodation for (nominally) 400 troops. The barrack-rooms, four on the ground floor and four on the upper floor, are 100 by 20 feet, with good windows at each end, but no openings, except a doorway, at the sides. They are therefore very difficult to ventilate. The accoutrement shelves are fixed to the walls, touching each other, and the bed-cots are very close together; but as only one company is at present in occupation, there is no overcrowding. Drinking water of good quality is laid on from the public supply. Collected rain-water is pumped up regimentally for washing and flushing purposes. The drainage system is partly modern and partly old, but is now nearly all remodelled. On the whole it is satisfactory. A foul catch-pit outside the married men's latrine, and a series of deeply-sunk silt traps in rear of the married quarters require certain obvious and easily practicable alterations. The latrines are on the dry earth system, with removal once a day only. Urinals are treated with lampblack and oil. These barracks are admirably situated for health, and are satisfactory in all important particulars.
Valletta Military Hospital contains 232 beds, and also has quarters for sixty-five non-commissioned officers and men of the Royal Army Medical Corps. The buildings are ancient, and not well adapted for hospital purposes according to modern requirements. The situation is unfavourable, as, although it borders on the Grand Harbour to the east, on the west and south it is closely surrounded by crowded dwellings of the poorer class; moreover, the principal wards are deprived of the beneficial effects of the cool north-west wind by reason of the lofty houses built on higher ground in that direction. The wards are lofty, and, on account of the thickness of the walls, cool in summer and warm in winter.

The principal feature in the hospital is the famous "Long Ward," probably the longest room in the world, being 503 feet in internal length, without any break in the continuity of the ceiling or east wall. Its width is 35 feet, and its height 32½ feet. Near the middle a transept is given off to the west, of nearly equal width and height, and about 100 feet in length, forming part of the same chamber. To facilitate administration the whole apartment is divided by partitions, 10 feet high, into northern, southern, central, and western portions (20A, 20B, 20, and 20c); but from a sanitary point of view it is all one chamber. In 20A are accommodated fifty patients, chiefly Mediterranean and enteric fevers; in 20B are sixty, venereal and slight cases; in 20 and 20c are slight fever cases. The cubic space is very large, 4,000 cubic feet per head, reckoning the whole height of 32½ feet; if the height be taken as 12 feet, it is over 1,500 cubic feet per head. These amounts appear to be ample. There are difficulties in ventilation, however, in spite of this ample cubic space, which, indeed, is of no advantage if it interferes with the free access of external, and exit of internal air. It is obviously more difficult to change the air of a room 30 feet wide than that of a room 10 feet wide, the amount of window space being the same in each case. In this instance the width is 35 feet, and the window space is not large. There are very few windows in the lower part of the walls. In the upper part there are plenty; but there is reason to believe that they have not been opened, and kept open, so freely as would have been desirable, and that consequently the ventilation of this large apartment has not been satisfactory. Notwithstanding its coolness and spaciousness, the difficulties in maintaining purity of the air,
and the impossibility of isolating the patients, render this "Long Ward" an undesirable place in which to treat the sick, although at first sight it appears to be very well adapted to the purpose. The wards on the upper floor are of moderate size and well ventilated. The flooring of the wards is of cement concrete, having a smooth, impermeable surface that is easy to keep clean.

The water supply is good and ample for all purposes. The drainage system has been entirely reconstructed within the last few years, and is in accordance with modern requirements; the drains discharge into the civil sewers at three different points, being cut off by proper disconnecting arrangements. Accessible inspection chambers are provided freely. A few points of detail in construction require attention, as, e.g., a proper grease trap for the cook-house; abolition of the large foul catch-pit near south-east corner of Lower Square. Other important requirements are (1) a new latrine for 20B Ward, the present one being in bad repair; (2) concreting the rough floor of latrine and urinal for No. 37 Ward.

The Families Hospital, though in rather a cramped situation, is fairly satisfactory.

The Royal Army Medical Corps barrack-room is a large apartment, 96 by 31 feet, with an annexe on one side, 28 by 17 feet. It is well lighted and airy in appearance, but on account of the great width and absence of cross ventilation it is difficult to secure a proper purity of the air.

Cottonera Hospital is a modern building of good general design, and is in an excellent, airy, and healthy situation, standing in its own grounds, at a considerable elevation. It has four large wards, 128 by 26 feet, of thirty-two beds each, and several smaller ones, 156 patients being accommodated in all. The wards are well designed, well lighted, and well ventilated. The ward annexes are capable of improvement. The principal sanitary defect in this hospital lies in the material of the ward floors, which are made of a soft and easily friable porous white stone; it wears away unevenly into holes, which are difficult to keep clean. The operation of ward-sweeping twice a day fills the air of the ward with fine dust, which is afterwards deposited on the patients, on their beds, and on any articles of food that may be exposed; a good deal of it must be inhaled. The floor spaces between the beds have been treated with some hardening preparation that makes the stone impermeable, but the main part of the floor in the centre has not been so treated. The provision
of a smooth, impermeable floor, as at Valletta, is an urgent necessity. Water supply and drainage are quite satisfactory.

Forrest Hospital (thirty-one beds) is a hired house, not designed for a hospital, but in as satisfactory a condition as can be expected. The water supply and drainage arrangements are in good order. A considerable number of the patients (twenty to thirty) are treated in tents all the year round (owing to want of sufficient accommodation), which greatly adds to the difficulties of maintaining a good sanitary condition of the hospital and its accessories.

Imtarfa Hospital (forty-two beds) is a new building constructed in accordance with modern principles, and is in every respect satisfactory.

Città Vecchia Sanitarium (eighty beds) is an old palace of the Knights, with large airy rooms, and well fitted for treating convalescent cases. The water supply and drainage are satisfactory.

Gozo Hospital contains fifteen beds, and is satisfactory in its situation and construction, water supply and drainage arrangements.

MARRIED QUARTERS.

There is accommodation for about 650 married families in the Maltese garrison, and in the majority of instances this accommodation is remarkably good. In this category are to be placed the two new blocks at Floriana, known as Misida Bastion (44 quarters), the new block in St. Francis Ravelin (6), the four new blocks at Tigne (65), D Block, St. George’s (10), all St. Andrew’s (36), Verdala New Block (24), Ricasoli new blocks (18), and all Imtarfa (55). These quarters are all excellent in every way, airy, and well ventilated, the water supply laid on, and good water-closets of modern wash-down pattern provided; in nearly every case also the situation is good; they are some of the most agreeable residences in the island. There are certain minor defects in sanitary detail that require attention, but nothing to interfere with their permanent usefulness, healthiness, or convenience.

The largest block of married quarters in Valletta is the building known as the Camerata, facing the Valletta Military Hospital; this accommodates ninety-two families, and is generally nearly full. It is an old building of six stories, and is comparable to a block of artisans’ dwellings in London. Being situated in the middle of the town, it is not so fresh and airy as other quarters, and some of the rooms are without direct communication with the external air. New closets of first-rate pattern have been recently supplied on each
floor, and the building is kept in admirably clean and good order; so that, in spite of its being somewhat crowded, it is really quite a sanitary and satisfactory block of dwellings.

The other older quarters, such as those in Upper and Lower St. Elmo, Floriana Pavilion (14), St. Francis Ravelin (16), Fort Manoel, the old blocks at St. George's (55), the old quarters at Ricasoli (20), St. Nicholas and Gozo (21), though not so convenient, or so well off in the way of closet accommodation and water supply, are, nevertheless, in a fairly good sanitary condition.

The large block of hired quarters in Strada Magazzini, Floriana, has been put into as good a condition as is practicable in regard to water supply and sanitary arrangements; but there are certain grave defects of construction in regard to the drainage (faulty pattern of w.c. liable to become untrapped, ill-ventilated closet chambers, inferior work in the underground drains) that prevent their being considered satisfactory quarters; they resemble the ordinary private houses in Valletta, &c., and are not to be compared to any of the newly erected married quarters that have been just mentioned. The hired quarters at Tigne are to be placed in the same category; those in Strada Capuccini, Floriana, are satisfactory.

There are some married quarters on the Cottonera side (Fort Salvatore (14), Vittoriosa (3), and St. Nicholas (Back) that are very undesirable residences, and, indeed, hardly fit for occupation.

On the whole, the accommodation for married families is extremely good, and, from a sanitary standpoint, very satisfactory.

(To be continued.)