Handbook on military sanitation for regimental officers / by K.B. Barnett.

HANDBOOK ON MILITARY SANITATION FOR REGIMENTAL OFFICERS

INTRODUCTION
BY
LT-GENERAL SIR H.L. SMITH-DORRIEN
K.C.B., D.S.O., A.D.C.

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M.B., B.Ch., F.R.C.S.I.
...L ARMY MEDICAL CORPS

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HANDBOOK ON

MILITARY SANITATION

FOR

REGIMENTAL OFFICERS

BY

MAJOR K. B. BARNETT

M.B., B.Ch., F.R.C.S.I.

Royal Army Medical Corps

WITH AN INTRODUCTION BY

LT.-GENERAL SIR HORACE L. SMITH-DORRIEN

K.C.B., D.S.O., A.D.C.

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JOHN MURRAY, Albemarle St., W.

PREFACE

When giving lectures to regimental officers on "Military Sanitation" during the last three winters at home, the author has often been asked to recommend a small book on the subject to supplement the official "Manual." He has found this difficult to do.

The present book has been prepared from notes used at these lectures, and an endeavour has been made to make it simple, practical and suitable for the requirements of the military reader. All technical terms have been, as far as possible, avoided or explained.

As the military text-books have been taken as a guide and references given for comparison and further study, it is hoped that this little volume may supply a want, and be found useful to regimental officers of all branches of the Army at Home and Abroad, not only for examination purposes, but also in their daily duties in Barracks, in Camp, and on the Line of March. The subject treated of is so important to the well-being of the Army as a whole, that no

apology is necessary for trying to stimulate the increasing interest already shown in Military Hygiene throughout the service.

The author's thanks are due to Lieut.-General Sir Horace Smith-Dorrien, K.C.B., D.S.O., etc., for kindly consenting to write a short introduction and so, by the influence of his name and military reputation, assisting the object for which this Handbook is specially published.

He also wishes to thank those brother officers and other friends who have helped him with their advice and criticism.

K. Bruce Barnett.

Shorncliffe Camp,
December, 1911.

"I AM convinced, from my experience of thirty years as a general, that the Army doctors should be regarded, not merely as healers of sick and wounded, but as trusted staff officers to advise their chiefs how to guard the troops against the originating and spreading of disease, and thus maintain the number of effectives in a campaign. This will result not only in the increasing of fire effect, but will raise immensely the fighting value of the troops, and will incidentally enable us to reduce the costly and cumbersome hospital establishments and transport."

"Tactics and the Health of the Army, 1848-1908," by FIELD-MARSHAL SIR EVELYN WOOD, V.C.
The Saturday Review, 14th Nov., 1908.

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LIST OF THE CHIEF AUTHORITIES CONSULTED IN THE PREPARATION OF THIS HANDBOOK.

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The Theory and Practice of Hygiene (Notter & Firth), 21s.

The Theory and Practice of Military Hygiene, by Edward L. Munson, A.M., M.D., Captain, Medical Department, United States Army.

Military Hygiene, by Lieut.-Colonel R. Caldwell, R.A.M.C., F.R.C.S.Eng., D.P.H., 3rd Edition, 10s. 6d.

Military Hygiene : a Manual of Sanitation for Soldiers, by Lieut.-Col. R. H. Firth, R.A.M.C., F.R.C.S., D.P.H., 3s. 6d.

Prevention of Disease in Armies in the Field, by Lieut.-Col. R. Caldwell, R.A.M.C., F.R.C.S.Eng., D.P.H., 5s.

A Handbook of Hygiene, by Lieut.-Col. A. M. Davies, D.P.H. (Camb.), 3rd Edition., 8s. 6d.

Military Sanitation and Hygiene, by E. Blake Knox, B.A., M.D., D.P.H. (Hons.), Captain R.A.M.C., 5s.

Official *Manual of Sanitation in its application to Military Life*, 1907, price 2d.

Manual of Bacteriology, Muir & Ritchie (Young J. Pentland).

The Real Triumph of Japan, L. L. Seaman, LL.D. (D. Appleton & Co.), 6s.

Army Medical Reports.

Journal of the Royal Army Medical Corps.

Journal of the Military Surgeons, U.S.A.

The Russo-Japanese War. Medical and Sanitary Reports, General Staff, War Office (1908).

INTRODUCTION

In the Russo-Japanese War in Manchuria in 1904 the Japanese Army suffered 250 casualties from disease to every 100 at the hands of the enemy.

Our figures in South Africa in 1899-1902 were 2,000 from disease to every hundred from the enemy. The question which has naturally arisen in the minds of all thinkers on the subject is, "Why had we eight men struck down by disease in our war to every man similarly struck down in the Japanese Army in their war?"

This question has resulted in a great deal of research, and in the acquisition of a large amount of information—and the real answer has been found in the fact that the Japanese for a long time previous to the war had made a fetish of "Practical Sanitation" in the Army, and, as the author of this book says on page 15, "This result, namely, their comparative freedom from sickness, would never have been obtained by the work of their medical department alone, however excellent, but was due to the recognition by all ranks, from the General in command

to the private soldier, of the requirements of modern sanitary teaching as applied to war, and to the ready obedience to all orders issued to the Army on the subject." Some excellent works have been produced on the subject, the one best known to me is called, *Military Hygiene : A Manual of Sanitation for Soldiers,* written by Colonel R. H. Firth, R.A.M.C., in 1908, when he was in charge of the School of Army Sanitation at Aldershot. This book is well worth studying, and now Major K. B. Barnett, R.A.M.C., has produced a book much on the same lines, and has asked me to write an introduction to it. I have consented to write it because my first-hand knowledge of the terrible toll paid to disease in war is, I submit, very considerable, and in support of this I would mention that I have spent nearly eight years of my life actually on active service, and I am hoping, by announcing this fact, that much more weight will be given to my advice to study works on Military Sanitation, than were I to write pages and pages of theory on the subject.

The history of our wars is one of casualties by disease out of all proportion to those by the enemy, and of which many might have been avoided had we possessed then the knowledge we have now, and also a well-equipped corps with a sufficient number of highly scientific, capable, zealous medical officers, such as our

Royal Army Medical Corps consists of at the present day. But, as the author points out in this book, the medical officer cannot bring about the best possible results unless he is supported everywhere by the regimental officer. The latter is always ready to give this support, but to do it efficiently he must know where the shoe pinches.

The authorities have fully recognised this, and in Army Order 3, dated January, 1908, included "Sanitation" as one of the subjects for the promotion examination of subalterns —and with a view to mastering their subject I recommend a careful study of such excellent books as this and Colonel Firth's.

Let me, however, implore all officers not to regard this study as primarily to help them to pass an examination, but rather to enable them to instruct each young officer and soldier on joining, and further to be able to put into practice themselves throughout their soldiering days, in peace or war, the suggestions and advice they find in these books.

In this careful work especially would I refer them to "Sanitation on the Line of March," commencing on page 127.

"The Dangers of Disease from Flies, especially with regard to Enteric," page 43, etc.

"Necessity for Inspection of Water-bottles by Company Officers," page 45.

"Dangers from Mosquitoes—Necessity and Methods for Destruction," page 51, etc.

"Protection of Water Supplies," page 79, etc.

On this latter subject the writer points out that the present filter water-cart, if looked after by a *trained* man, is a considerable advance, but I would emphasise that a *trained* man is required, and commanding officers should see to it that they have a supply of such men always ready to help the R.A.M.C. man in charge, or even to take sole charge of the cart if necessary. I am hoping something still better in this direction may yet be devised, such as the "Griffith Steriliser," which though not perfect is very good. It, mounted on a two-wheel cart, is capable of drawing by pipe and pump from the most awkwardly situated supply 350 gallons an hour, and of passing the same amount out for use in that time as pure, innocuous water, no matter how filthy the source from which it is drawn. I have had practical experience of this steriliser at Aldershot, and it is fully described in Colonel Firth's book. I believe the medical authorities do not consider it quite satisfactory in practice, but doubtless something on the same lines will be devised for ensuring a supply of pure water to an army in the field.

I wish, in conclusion, to emphasise that the careful supervision of the regimental officer is required almost as much in peace as it is in war.

The authorities have done a great deal, and are doing still more, to provide the soldier with airy, healthy surroundings, better light, separate dining-rooms and kitchens, cooking ranges, latrines and urinals, all of the best and most sanitary type. But these improvements may take years to complete, and meanwhile such abominations as the old urine tub at the barrack room door will continue to exist, and whilst it exists the watchful eyes of the company officers and non-commissioned officers are very necessary, otherwise flies will flourish and disease will result. I do not wish to imply that the regimental as well as the medical officer has not already done a great deal, or that my advice is even necessary to the majority of them, but my appeal is intended chiefly for the young officers who are ignorant of the subject. We may well be proud of the improvement in health of the Army, both in the United Kingdom and India, during the last few years, and for it we have to thank the great advance made and being made in sanitary precautions. Let us thoroughly study the latter and apply them in our next campaign, and we shall enormously reduce the necessity for frequent reserves, such as poured into South Africa in their thousands throughout the years 1900 to 1902.

In that War we read in this book that admissions to hospital from disease amounted to

450,000, and only 22,000 from wounds. If we apply the Japanese proportion to which I referred in the opening lines of this introduction, we should have to divide the 450,000 by 8, and our admissions by disease would only have stood at 56,250—a saving of 393,750 casualties by disease. Think what that spells, in fighting efficiency, to say nothing of the saving in time and money. These figures alone show what knowledge and observation of sanitary precautions can do.

H. L. SMITH-DORRIEN,
Lieut.-Gen., C.-in-C., Aldershot.

GOVERNMENT HOUSE,
October 29, 1911.

HANDBOOK ON MILITARY SANITATION FOR REGIMENTAL OFFICERS

CHAPTER I

INTRODUCTORY

Definition of Sanitation.—The popular idea of Sanitation is "something to do with drains and smells," but in its application to military life it has a much wider significance, and includes all the methods to be adopted to preserve the health of the soldier in peace and war, at home and abroad. Its importance to the Army is difficult to over-estimate. Sometimes it is spoken of as *Military Hygiene*, which is perhaps a better name, *Hygiene* being the science which treats of the preservation of health, while *Sanitation* is the practical application of this science to everyday life.

The Importance of the Education of the Recruit.—It is generally admitted that prevention is better than cure. Lord Nelson in 1804 wrote: "The great thing in all military service

is health ; and you will agree with me that it is easier for an officer to keep men healthy than for a physician to cure them."

We have to deal with a short service Army in which the recruits are nominally sound on enlistment, though often, as statistics show, very immature and frequently suffering from want of food, the result of unemployment. These men, who average 18 to 19 years of age, are unable to perform the work of the mature soldier properly for at least two years, and as far as possible must be kept from contracting disease. It is to them that special attention ought to be devoted, so that they may learn the importance of cleanliness at the commencement of their military career.

Civil and Military Sanitation.—In civil life sanitation is managed by a special public department responsible for public health, the Medical Inspection Branch of the Local Government Board, with a large staff of inspectors and strict bye-laws, so that the ordinary individual of the class from which the recruit is drawn is not required to think for himself in these matters. In military life these responsibilities have to be undertaken by the Army itself, and a knowledge of this subject is therefore necessary.

The Results of Sanitation.—Two hundred years ago, when sanitation was unknown, the mortality in London was 80 per 1000, at present

it is less than 15 per 1000, and London is one of the healthiest of the great cities of the world. Little more than one hundred years ago ships could scarcely keep the sea for Scurvy ; prisons, workhouses, and even hospitals were in many cases hotbeds of disease. To-day Scurvy is unknown in the Royal Navy, and very rare in the Mercantile Marine, and prisons are almost the healthiest buildings known. Less than fifty years ago British troops at home died at the rate of 20 per 1000, the death-rate is now under 4. Typhus Fever, Dysentery and Ague, although very common 150 years ago, have almost disappeared at home ; Smallpox has been robbed of its terrors, and almost stamped out by vaccination. These changes have been chiefly brought about by great advances in the study of the origin and causation of diseases, combined with improved general education and assisted by an enlightened Legislature and a free press.

Sanitation, of which England was the pioneer and still is well to the front, has taken the place of the once all-pervading squalor and dirt. The great importance of safeguarding the public health has only been fully recognised in comparatively recent years, and still more recently has its special application to the Army been given due consideration and support from those in high authority.

Origin of Sanitation.—The earliest record of military sanitation will probably be found in the Mosaic laws relating to the cleanliness of the Jewish Army in camp (see Deut. xxiii. 12, 13, 14). The Greeks and Romans devoted much study to the conditions of health and physical culture, as their aqueducts, baths and other public and sanitary works, some of which still exist, testify. Classical authors on medicine, like Hippocrates, Galen and Celsus, have written on the subject.

Ceremonial purification was and is associated with many religions, such as that of ancient Egypt, Shintoism, Buddhism, Mohammedanism, Hinduism, etc., and even Christians speak of cleanliness being "next to godliness."

Influence of the "White Man."—Civilisation no doubt brings many diseases in its train which were almost unknown among communities living under more primitive conditions and with strict tribal laws. The influence of the "white man" does not always appear to be for the best —witness the Belgian Congo some years ago.

Preventable Diseases.—Preventable diseases mainly arise from insanitary conditions, or, in other words, from a want of cleanliness and neglect of the common-sense rules which govern health, and do not arise *de novo* as was formerly believed. It is not suggested that all diseases can be prevented. The history of sanitary

improvements, like the introduction of new designs and discoveries, is the history of one continued struggle against the prejudices and opinions of the age. Sanitation is not so much a special science, as the application to practical ends of principles derived from other sciences. As dirt has been described as "matter out of place," all that is required in this respect by sanitation is to put it into its proper place, so that it no longer exists.

The Needs of the Average Man.—It has been said that a man can live three minutes without air, three days without water, and three weeks without food, and this may be taken roughly to represent the relative importance of the three chief daily needs of the average man, fresh air, water and food. In addition, he requires clothing and a suitable dwelling. In a civilised community, in connection with the supply of water, the removal of sewage has to be arranged for, to prevent pollution of the air and water. Healthy dwellings include a study of their position, or site, construction, heating, lighting, ventilation, water supply and drainage. The complete study of hygiene therefore embraces the subjects of soils and sites, climate, meteorology, food, clothing, exercise, physical training, and, in relation to the causation and prevention of disease, micro-organisms. In order to prevent disease, it is necessary first to understand its

cause. In the case of preventable diseases, this cause means a special poison or microbe, which must be destroyed by every available means.

Origin of Military Sanitation.—In the past, military sanitation has been treated too much as a subject for experts, while the importance of a knowledge of this subject generally in the Army has not been sufficiently realised.

The present Army Medical Service dates from the introduction of sanitation, and many other much-needed reforms into the Army at the end of the Crimean War of 1854-5. This was chiefly brought about by the historical letters of Russell to *The Times* newspaper, describing the wretched condition of our brave troops in hospital and in the trenches before Sebastopol. This was followed by the well-known labours of Florence Nightingale and her band of helpers in the hospitals at Scutari, and by the arrival of ships with the much-needed supplies of clothing and stores for the Army. The late Miss Nightingale wrote: "I have known intimately the Sardinian soldier, the French soldier, and the British soldier. The Sardinian soldier was much better appointed than we were; the French were both more numerous and much better appointed, and more accustomed to war; yet I have no hesitation in saying that we had the better military spirit, the true volunteer spirit, to endure hardship for our country's

sake." So sickness and death produced at last the much-needed change.

The Geneva Convention.—In a somewhat similar manner the sufferings of the Italian soldiers after the Battle of Solferino, in the Italian campaign of 1859, and the publication of the pamphlet by Dunant in 1863, entitled "Un Souvenir de Solferino," which caused a sensation throughout Europe, led to the first Geneva Convention of 1864, "for the improvement of the condition of the wounded of armies in the field."

Lord Herbert* and the British Soldier.—Lord Herbert, whose name is handed down in the Royal Herbert Military Hospital at Woolwich, did more to promote the welfare of the British soldier than probably any man before or since. We are told that his great object was to impress on Parliament, in regard to sickness, that prevention is better than cure. In the year 1859 he wrote: "If the education of Military officers comprehended a knowledge of the principles of sanitary science, commanding officers might safely be left to their own judgment in adopting sanitary precautions for protecting the health of the men." In the year 1861 regular lectures on sanitary matters were delivered at the Military

*Mr. Sidney Herbert, Secretary of State for War, was created Lord Herbert of Lea in 1861, and died six months after receiving a peerage.

School of St. Cyr in Paris. The South African War, which has taught many things, has emphasised the necessity of paying still more attention to sanitation with our troops in the field. According to General Nogi, the Japanese took ten years, namely from 1894 to 1904, to teach their Army sanitation, and with the best results.

Present Position of Army Sanitation.—Sanitation in the Army has now been placed on a much more definite footing. In 1906, a "School of Army Sanitation" was opened at Aldershot for the instruction of officers, N.C.O.'s and men of all branches of the Service (see para. 782, K.R.). On the 1st February, 1907, a short "Manual of Sanitation in its Application to Military Life" was issued with Army Orders (at present under revision), also "Health Memoranda," a pamphlet issued to each man on enlistment. Lectures are now given annually at the Staff College, to the senior cadets at Woolwich and Sandhurst, and to officers at the larger garrisons at home and abroad.

By Army Order 3, dated January, 1908, all officers before promotion to the rank of captain, and all cadets before appointment to commissions in the Regular Forces are required to pass an examination in Military Sanitation, as suggested by Lord Herbert in 1859 (see para. 853, and App. XI., K.R.).

The Object of Sanitary Teaching.—The object of all this teaching is that officers may be able to give simple instruction to their N.C.O.'s and men, and so get a knowledge of the elements of sanitation down to the rank and file, as, until this is done, our Army is not safe. "The general principles of sanitation must be known to all ranks" (see F.S. Regs., Part II., p. 92).

Responsibility of Commanding Officers.—Commanding officers are now made responsible for the sanitation of their own units in peace and war (see para. 100, K.R., and F.S. Regs., Part II., Sec. 71). They have, as formerly, medical officers to advise them, but in addition, they now have a trained organisation to assist them in carrying out these duties, which they may develop to any extent. By referring to the official books quoted, the chapter and verse will be found for the measures recommended. (See also Ch. VII.)

The Co-operation of all Officers required.—Orders and regulations with reference to this subject are worthless unless strictly enforced by all regimental and other officers, and carried out thoroughly with an intelligent knowledge of their importance by the men; after a time this will almost become automatic. It has been said that, "a little learning is a dangerous thing," and this is generally true, but an exception may perhaps be made of a little sanitary

knowledge, which may be the means of saving valuable lives. The co-operation of all officers, and through them, of all non-commissioned officers, who are in daily touch with the men, is what is wanted. These matters must not be left entirely to the hard-worked Quartermaster and his staff, as they so often are, with occasional suggestions from the inspecting medical officer; squadron, battery and company officers can have the necessary work much better done themselves, and a personal interest taken by them in this subject, with a little good example and advice, is worth a volume of regulations. N.C.O.'s and men instinctively follow the leadership and example of their own officers, and, if they see their officers disregarding the rules of hygiene, it is only natural that they should do so also.

Fitness for War, the Test.—A standing Army exists at present for fighting, despite the most ardent advocates of arbitration, and has been called "food for powder." It is very expensive, each man trained and sent abroad costing the State about £100. It must be kept in health, and so prevent depletion of the fighting ranks by preventable disease (see F.S.R., Part I., Sec. 46 (1)). This is specially necessary in our Army on account of its comparative smallness, and the limited number of our Reserves. No Army that is prone to disease can be considered fit for war. If the Army is to be kept

"fit" in time of war, the laws of hygiene must be observed, and sanitation practised during the so-called "piping times of peace," if not done, then it will be too late to begin on the outbreak of war. There is no desire to make every officer into a medical expert, one can be artistic without being an artist, and know where a road or a bridge is necessary without being an engineer. Strategy, tactics, fortification, in fact the whole "art of war," must be studied during peace, if success in war is to be attained; and, in the same way, the men must be taught to safeguard their own health and that of their comrades during peace, at home and abroad, if they are to be expected to ride, march and shoot straight, when the excitement of active service actually occurs. In our next war we may have to meet an enemy as well disciplined and trained as ourselves, a point which Englishmen are rather too apt to under-estimate.

The Man behind the Gun.—It was said of one commander in a recent war that when asked to facilitate the passage of medical supplies towards the front, he used the expression, "bullets before pills." That is all very well so long as the men are able to use the bullets in the firing line, when they have to go to the field ambulances and so towards the base through preventable sickness, the ammunition in their pouches or bandoliers is of little service to them.

At one time in 1900, during the advance of Lord Roberts' army into the Transvaal, it is stated that there were as many as 11,000 men unfit for duty. Marshall Saxe, a high authority on military matters, was in the habit of saying, "that to kill a man in battle, the man's weight in lead must be expended." Disease, as will be shown, is much more deadly. Occasions must arise on service, when hygienic considerations have to give way to the more pressing requirements of war, but this is no argument against attention to these matters, as far as practicable, at all times, during peace and war. It is wonderful how things can be done even under the most unfavourable conditions, when once their importance is understood. It would perhaps not be too much to affirm, that in the next big war, freedom from sickness, or otherwise, will count as an important factor, other things being equal, in determining the final result; and that a regiment with a high sick-rate will earn a bad reputation for itself and its officers. What the result is to be will depend chiefly on the intelligence and discipline of all ranks, and no medical service in the world can relieve an Army of this responsibility.

If a fraction of the supervision and attention that is daily devoted by officers, especially in the mounted branches of the Service, to arms and equipment, horses, saddles and harness,

was given to the sanitation of their own units, a most marked improvement would soon be visible. Guns, rifles and ammunition require constant attention and study, but the "man behind the gun," in war as in sport, is of at least equal importance, and must not be forgotten. His housing, physical training, food, clothing and general sanitary environment, must all be carefully supervised, if he is to keep his place in the ranks. This has been considered of supreme importance by the most successful military commanders of modern times. By attention to details in these matters the general efficiency and *morale* of an Army will be maintained, and its mobility greatly increased.

Losses by Disease in War.—In all wars the losses by disease have been much greater than those sustained by the acts of the enemy. In South Africa (1899-1902), 450,000 were treated for disease, and only 22,000 for wounds, injuries and accidents combined, a ratio of over 20 to 1.

Enteric Fever and *Dysentery* alone accounted for 74,000 admissions to hospital, and 9,000 deaths. At Bloemfontein, in May and June, 1900, there were as many as 5,000 cases of Enteric Fever alone in the military hospitals at one time. During the three years' campaign, these two diseases, which are to a large extent preventable, accounted for one-sixth of the total admissions to hospital, two-thirds of the total

deaths by disease, and nearly half of the total losses by death from all causes during the war; apart from them, the medical casualties of the war would have been comparatively insignificant.

In the ill-fated Walcheren expedition of 1809, 347 men per 1000 died from disease, and only 16 per 1000 by the hands of the enemy, creating an easy record in modern English history.

In the Peninsular War and in the Crimea, the ravages of disease at times were almost as appalling. The French in Madagascar in 1894, lost one-third of their force from disease. The United States, in their war against Spain, had their Army decimated by disease before it ever set foot in Cuba.

These details show the results of climatic and insanitary conditions combined, when large bodies of troops are gathered together for war, when the diseases above mentioned have been shown to be about *six times* more prevalent than in an Army in peace garrisons. In our more recent wars and expeditions, from *Ashanti* (1873-4) down to the last *Anglo-Boer* War, numbering in all 19, for every man admitted to hospital for some wound or injury, 25 were admitted for disease, and 5 died of disease for every 1 that died from wounds or injuries.

The *Russo-Japanese* War of 1904-5 has since taken place, and even allowing for Japanese official secrecy and other peculiarities, their

statistics show a very distinct improvement on the results of their own war with China in 1894-5.

Sanitation in Manchuria.—The Japanese nation has only emerged from a state of Oriental civilisation since the year 1868, when, after the Revolution, it adopted Western manners and customs. Its Army and Navy are now organised and trained after the best European models. In Manchuria, by strict attention to sanitation, they endeavoured to preserve the health of their large Army during the cold of an almost arctic winter and the heat of a sub-tropical summer, as they recognised that with a heavy sick-rate they would have no chance against the immense military resources of the Russian Empire. The result of the war proved that they acted wisely. This result, namely, their comparative freedom from sickness, would never have been obtained by the work of their medical department alone, however excellent, but was due to the recognition by all ranks, from the general in command to the private soldier, of the requirements of modern sanitary teaching as applied to war, and to the ready obedience to all orders issued to the Army on this subject. Their admission rate to hospital for disease, in comparison to wounds, was in the war with Russia as 2·5 to 1, whereas in their war with China, ten years before, it was as 56 to 1.

Japanese Patriotism.—The soldier of the Mongolian races does not appear to be subject to quite the same diseases as the white soldier, either in peace or war, and much allowance must be made for these racial and constitutional differences in instituting comparisons between them. The Japanese soldier is tough inside as well as outside, and accustomed to extremes of climate and hard work. His field ration is simple, contains only a small allowance of meat, and he usually drinks boiled water in the shape of tea and alcohol only in very moderate quantities on service. Japanese chivalry, or *bushido*, as it is called, which really won the war for Japan, is the outcome of centuries of family training among the *Samurai*, or fighting clans, disbanded on the abolition of the feudal system after 1868, but whose descendants largely constitute the personnel of the Army and Navy, and manage the affairs of State in Japan to-day. There is no "Little Japan" party. Forty years ago Western science was practically unknown, but unparalleled progress has since been made. In the recent war against Russia, the Japanese Army was in some particulars better equipped than ours was in South Africa.

Comparison of Medical Statistics.—A great deal of nonsense has appeared in print as regards the freedom from sickness in the

Japanese Army, as compared with the British Army in South Africa. It must not be forgotten, however, that the South African War lasted 31, and the Russo-Japanese War only 18 months. The Japanese admission rate for disease is considerably, but not very strikingly lower than the British, namely, 589·6 to 727·0, while their death-rate from disease is higher, namely 31·2 to 24·4 (annual ratio per 1000 mean strength). On the other hand, as regards wounds, their death-rate from this cause was exactly *one-half* of what ours was in South Africa. The great difference in the proportion between the Japanese and British admission rate for diseases, as compared with the admission rate for wounds, "is due to the nature of the engagements in which the Japanese forces took part, and to the excessive number of wounds rather than to any special difference in the numbers of admissions from disease."

The Russian statistics in this war appear to have been as satisfactory as the Japanese, but (*comparatively*) few details are available. As regards the Russian soldier, Colonel Waters, C.V.O., C.M.G., states, that "he is of such good physique, and as a rule so inured to privation in his own home, that he can, in my opinion, stand campaigning better than any other European soldier."

CHAPTER II

THE CAUSE OF DISEASE

It is now admitted that disease generally arises from a distinct living organism which, under favourable conditions, enters the body, multiplies there, and gives rise to the symptoms of a particular illness. The study of disease germs under the microscope, which is known as Bacteriology, has enabled this to be proved. Each microbe is derived from a previous case of the same disease, and it produces that disease and no other; Smallpox causes Smallpox and not Measles, or any other disease.

The Micro-organisms of Disease.—The majority of these living germs belong to the lower forms of the vegetable kingdom (*Schizomycetæ*), but a few belong to the animal kingdom, and from their resemblance to the most primitive forms of animal life known, are called *Amœba*—as the organism named *Hæmamœba*, which causes Malarial Fever. They are all microscopic in size, and are often spoken of collectively as *Bacteria*. They are given names on account of their special shapes, such as

Micrococci (round-shaped), Bacilli (rod-shaped), Spirilla (spiral-shaped), etc. They multiply very rapidly by division, or by the formation of spores or seeds.

The great majority of the micro-organisms found in nature are quite harmless, in fact, are necessary to life, and it is only a small number that are concerned in the production and spread of disease. These latter are referred to technically as *pathogenic* micro-organisms.

Where they Live and how they Act.—The micro-organisms of disease live and multiply generally in the blood and other fluids of the body, where they find a suitable temperature, and *pabulum* or food for their growth. While growing and multiplying they produce and excrete a poison, or *toxin*, as it is called, and it is the circulation in the blood of this toxin which gives rise to the symptoms of disease, such as fever.

Whether the person attacked will recover or not depends partly on his general health, and partly on his power of manufacturing an antidote, or *antitoxin*, in his body.

The white corpuscles of the blood also play a most important *rôle* in this struggle against disease. (See Ch. III., *Predisposing Causes of Disease.*)

If the body is in vigorous health, in many cases the disease-producing organisms are gradually killed, and their poisons neutralised; on the

other hand, if this is not so, the disease gains the victory. This is shortly what has been termed the *germ theory of disease.*

It resembles what is so well known to occur in the manufacture of wine, beer, etc., by the action of yeast and other ferments. The sugary fluid produced from the crushed grapes in the manufacture of wine is fermented by the action of germs in the wine-vat, and the sugar in it is split up into carbonic acid gas and alcohol. When the amount of the latter reaches 14 per cent. of the fluid, fermentation ceases automatically, very much in the same way as in the human body the temperature or fever falls and convalescence begins, when sufficient antitoxin has been produced to neutralise the organisms giving rise to the illness.

Infectious and Contagious Diseases.—In all these infective diseases living organisms gain entrance to the body, then there is a period during which there is no rise of temperature, called the *incubation period;* this period is followed by the fever, or illness, and, eventually by recovery, or death, as the case may be.

In many of these diseases one attack protects the individual from a second attack at least for some time, although second attacks are not uncommon. Some diseases, such as Smallpox, Scarlet Fever and Measles, are more easily communicated than others, and are spoken of

as *infectious*, to distinguish them from others called *contagious*, where direct contact between the sick and healthy is supposed to be necessary to spread the infection. In reality, there is no hard-and-fast line, and all these germ diseases may be called infectious. During the illness (even before the disease can be recognised), and often during convalescence, the sick are able to communicate the sickness to others who are not protected by having had a previous attack, or by protective inoculation or vaccination.

How Disease is Spread.—Disease is spread in many different ways. In Scarlet Fever, Diphtheria, Measles, Influenza, etc., the secretions of the throat and breathing passages carry the infection. In Smallpox, the eruption on the skin, in Enteric Fever, Cholera and Dysentery, the stools, urine or vomited matters are all infectious. In Smallpox, the infection can be carried to a considerable distance, probably by the air, while in other diseases more or less direct contact with the sick is necessary.

The bodies of men and animals dead of infectious diseases are full of infective organisms, and therefore dangerous. They should be disposed of by burning, if possible, otherwise by being deeply buried with quicklime, and well outside the camp perimeter. (See F.S.R., Part I., See 56 (6).)

All articles used by the sick are capable of spreading infection, and should be disinfected or burnt. (See Ch. III.)

Germs Outside the Body.—Although the human body is the breeding-place and storehouse of disease germs, these find their way outside the body, and may live for a considerable time in the soil, in dust, in decaying animal and vegetable matter of all kinds ; as a rule, warmth and moisture are favourable for their growth and multiplication.

Flies and Disease.—The common house fly lays its eggs especially in stable litter, and thousands of flies are developed in this way in the course of nine or ten days. Flies have been proved to be carriers of disease germs ; their presence may often be taken as an index of want of cleanliness, and they should be exterminated by every possible means. The same treatment should be extended for the same reason to vermin of all kinds. (See Ch. IV., Enteric Fever and Plague.)

Mr. W. E. Collinge at the conference of the Association of Economic Biologists at Birmingham University recently said that the belief that flies were capable of carrying germs of infectious diseases was not new. In the latter part of the sixteenth century they were held to be the agent of transmission in connection with the virus of Plague

"There was," he added, "no longer any doubt that Cholera and Typhoid Fever were spread by flies, and there was a large amount of evidence that Dysentery and Tuberculosis were also."

Channels of Infection.—The chief channels by which these organisms enter the body are the lining membranes of the breathing and digestive passages (lungs and stomach), and through the skin. We can get infection by means of the air we breathe, by food or drink swallowed, or from cuts, scratches, bites of insects or animals, which is generally termed inoculation. Water and milk are common sources of infection, also uncooked vegetables, such as salads, and shellfish, such as oysters, polluted by sewage. Cholera and Enteric Fever are the chief diseases spread in this way.

Milk may be contaminated by being handled by an infected person, more commonly by being diluted with infected water, or placed in infected vessels, and in this way has caused many epidemics; or by carrying disease from the cow or goat, as Tuberculosis and Malta Fever. (See Ch. IV.)

Water may be contaminated by sewage, or by the excreta of a single infected person getting into the common water supply. (See Ch. V.)

Air. When the air is the source of infection,

the germs of disease probably gain an entrance into the body mixed with dust in the act of breathing or swallowing, as in Smallpox, Consumption, and sometimes Enteric Fever. (See Ch. VI.)

Germs which Enter through the Skin.—Examples of diseases caused by damage to the skin are *Tetanus* (Lockjaw), the organism of which lives in the soil, especially in warm climates, and this should always be carefully removed from all slight wounds or abrasions of the skin, commonly called "gravel rashes."

Malaria and *Yellow Fever* are produced by the bites of infected mosquitos, *Plague* by the bites of the fleas of plague-stricken rats, *Sleeping Sickness* by the bites of a special fly found in parts of Africa (Uganda, etc.). Dirty clothes, razors and brushes are often the means of communicating skin diseases, such as Itch.

In addition, both unboiled water and food uncooked, or insufficiently cooked, are frequently the means of conveying into the human body minute parasites in the form of eggs or worms, which cause many diseases, such as the '*Red Water*' of South and West Africa (Bilharzia), Elephantiasis (a disease of the East), Guineaworm, Tapeworm, Flukeworm, Roundworm, etc. It may be accepted as a general rule that fresh air, sunlight, dryness and absolute cleanliness are destructive to

most disease germs. Sanitation teaches the guarding of all possible channels of infection, so that no loophole may be left open.

Susceptibility to Disease.—Some persons contract illnesses very readily, or are very susceptible; others do not, being more or less proof against them, which is termed immunity, or being immune. This difference depends on many causes, including age, sex, family history, constitution, climate, season, etc. The digestive fluid of the stomach, called the gastric juice, which is only poured out when there is food in the stomach, is destructive to many organisms, such as those which produce Cholera and Enteric Fever. If bad water at any time has to be drunk, as it often has on service, or cholera-camps have to be visited, it is always best to have something to eat first.

The natural tendency of the healthy body is to resist infection, and if disease results, the tendency is also always towards recovery, medical treatment being mainly directed to assist nature in overcoming the invasion by plenty of fresh air, suitable food, nursing, etc. When the constitution is delicate, as it is termed, or when a person is "off colour," and the system run down by privation, exposure, residence in the Tropics, bodily or mental fatigue, etc., the resistance of the body against disease is very much reduced.

Causes which Lower Resistance.—With an Army in the field, the chief favourable factors for the spread of disease are *nearly always* present, and as long as war is war, are not likely to disappear altogether. They may be classified as follows :—

(1) The resisting power of the individual is lowered by fatigue, want of sleep, scanty, indifferent, and often badly-cooked food ("bully" beef and biscuits), and by exposure in the British Army to varying conditions of climate in an Empire "upon which the sun never sets."

(2) The great majority of the men are under 25 years of age, and therefore specially susceptible to some diseases such as Enteric Fever. They are either massed together in the open in bivouacs, or crowded in badly-ventilated tents or billets, living and sleeping in the same clothes, and frequently unable to wash. The circular, or "bell tent," used in our Army (except in India), with 15 men and their kits, arms, and accoutrements inside, and the door laced up, especially in wet weather, is certainly not a "model dwelling." When infectious

disease breaks out in camp under these conditions of overcrowding, it is very difficult to prevent it from spreading. Bivouacs are certainly more healthy in warm and dry weather even with cold nights, on account of the fresh air, and this was specially noticed in South Africa. Napoleon considered the bivouac to be the healthiest form of camp, but medical writers at the time attributed much of the sick-rate and mortality in the French army to the fact that "Napoleon habitually required his troops to bivouac during campaign." (See Ch. VI., Bivouacs.)

(3) Camping grounds are frequently fouled by the refuse and excreta of previous bodies of troops or natives, and generally contain the germs of disease. Dust storms, dust "devils" and flies, carry these germs everywhere, even if the camp is not actually pitched on a polluted site.

(4) The water supply is frequently contaminated, or liable to contamination, and boiled water not being used always for drinking and washing up, epidemic disease is often the result.

Other Causes favouring Disease.—*The Abuse*

of Alcohol tends to lower the resisting power of the soldier. Men who are in the habit of drinking alcohol to excess are the first to fall out on the march from exhaustion due to heat, cold, etc., and if they contract disease, their chances of recovery are much less than with the abstainer or moderate drinker.

This fact is well known to all explorers, sportsmen, athletes and trainers, as well as to the medical profession. Although a great improvement has taken place in the Army as in civil life in recent years in the matter of drinking, there is still room for improvement. Many men habitually drink too much who never get an entry for "*drunkenness*" in the "Regimental Conduct Sheet," or an admission to hospital for "*alcoholism.*" (See also Ch. VII., The Issue of Rum.)

Excessive smoking of cheap cigarettes by young soldiers in our Army is said to be the cause of much invaliding and inefficiency from "Disordered Action of the Heart," etc., and although Japanese, Russian and Turkish troops are inveterate cigarette smokers, their tobacco does not appear to have the same injurious effect on their heart and lungs. The moderate use of good tobacco, in the pipe especially, has much to recommend it from a military point of view. Field-Marshall Lord Grenfell and Lieut.-General Sir L. J. Oliphant, C.B., have directed special

attention to and issued orders on this subject.

A man who has recently suffered from disease has his vitality and power of resistance very much lowered, which explains much of the high death-rate and invaliding from India and other foreign stations, where the enervating effects of a tropical climate, combined with recurring attacks of Malaria, Dysentery, etc., impoverish the blood and make the sufferer a ready prey to disease.

Disease Prevention.—All disease prevention may thus be arranged under two headings, namely—

(1) *Prevent the disease germs entering the body.*

(2) *Keep up the resisting powers of the individual by every possible means.*

All endeavours should be directed to keep the soldier, from the day of his enlistment during his service with the colours, in a condition to resist the attacks of disease, by teaching him to cultivate cleanliness as a most important *duty*, by supplying him with wholesome food and drink, suitable clothing and equipment, and housing him in clean and well-ventilated barrack-rooms, or in sanitary billets and camps.

Physical Training.—In addition to the above, the physical training of the recruit is most

important to enable him to undertake his work as a soldier, as on joining he is not in a fit state to do this. " Purely military exercises, drill, route marching, rifle exercises, stable duties, riding, gun drill, etc., are not sufficient, however gradually they may be taken, to put him into the required state of physical fitness. Neither is it possible by means of these military exercises alone to correct the bad habits too often acquired before enlistment." (See " Manual of Physical Training, 1908.")

CHAPTER III

EXPLANATION OF TERMS

BEFORE describing some of the chief preventable diseases met with in the Army, it is necessary first to explain shortly a few of the terms in common use.

Pre-disposing Causes of Disease.—The pre-disposing causes of disease are any conditions which lower the health and thus the vitality of the blood and tissues of the body generally. In Chapter II., under "Causes which Lower Resistance," most of these have been given. The healthy body is able as a rule to ward off the attacks of disease-producing organisms through the activity of the blood, and especially of one of its constituents, the white blood corpuscles. These corpuscles, though not nearly so numerous as the red corpuscles (about 1 to 500), have a most important part to play in the fight against disease, namely, to attack and destroy, if possible, all disease-producing germs, which may gain an entrance. (See Ch. IV., Malaria).

Exciting Cause of Disease.—With reference to the Diseases under consideration, this

means the entrance into the body of the particular living germ which has been proved in many cases to cause the disease in question. *Examples:*—The exciting cause of Cholera is the "comma bacillus" of Koch, and of Enteric Fever, "the bacillus typhosus." In some diseases, such as for instance Typhus Fever, Measles, etc., the particular organism causing the disease has not yet been discovered.

Immunity to Disease.—This is usually described as being of three varieties.

(1) *Natural immunity* signifies the power possessed by man and animals to resist infection by certain diseases.

(2) *Acquired immunity* refers to the fact that one attack of many acute diseases, such as, for instance, Smallpox, generally protects the person, for a time at least, against a second attack.

(3) *Artificial immunity* is the name given to the protection afforded against certain diseases by inoculation with the organisms (or their toxins) which produce them, as in anti-typhoid inoculation, etc.

Protective Inoculation.—The original idea of this form of treatment goes back to the time when people were inoculated with Smallpox directly from the sick, which by giving them a

milder attack, protected them against the ordinary form of this disease. This custom was first brought to England by Lady Mary Wortley Montagu, the wife of our Ambassador to Turkey, in the early part of the eighteenth century, and her example was widely followed. There was a serious disadvantage attached to this proceeding, however, as the Smallpox induced by inoculation, though mild, was infectious, and the spread of the disease was thus favoured. This practice consequently fell into disrepute, and gave place to *vaccination*, or the inoculation of Cowpox, discovered by Jenner, in 1796. He found that cows were subject to Smallpox in a modified form, that the milkers contracted the disease from the cow, but were not susceptible to Smallpox (no doubt accounting for the well-known reputation of the country milk-maid for beauty), and also that those who had suffered from Smallpox did not afterwards contract Cowpox.

Vaccination.—The operation of giving people Cowpox, or Smallpox modified by first passing through the cow or calf, is called vaccination, and the material used is called vaccine lymph.

Preparation of Vaccine Lymph.—The calf is first vaccinated with human Smallpox, which produces blisters at the point of inoculation, but does not make the animal ill. The fluid or lymph from these blisters is collected, mixed

with a little glycerine, and kept sealed up in glass tubes in the dark for some time, to make quite certain that it is sterile, or free from germs. It is then sold as glycerinated calf lymph for vaccination, and protects the individual so treated in a most marked way against the infection of Smallpox, as has been proved by Royal Commission, and by experience in every country of the world, from "China to Peru," where Smallpox is prevalent.

Compulsory Vaccination.—All recruits on joining the Army, the wives and children of all soldiers married "on the strength," must be vaccinated, and persons in the Army who have been exposed to infection, or, when Smallpox is prevalent, if not bearing good marks, must be re-vaccinated. The regulations on this subject are strictly enforced, and an annual inspection made (see Para. 1502 K.R.). The recent epidemics of Smallpox among civil communities in England can be traced to the "conscientious objection" clause in the Vaccination Act, 1907, and the practice of parents objecting to have their children vaccinated for this reason appears to be growing a common one.

Smallpox in War.—In the Franco-German War of 1870-71, the French lost 26,000 men by an epidemic of this disease, the Germans, although occupying the same camps and even making prisoners of the sick, escaped, as they

were all thoroughly vaccinated, whereas the French were not.

Diphtheria Antitoxin.—If the horse is inoculated with the germs of human Diphtheria it has been found that he does not become ill, but if some of the clear part of his blood, or serum, is drawn off, and injected into the human body, it acts as an antidote to the poison of Diphtheria. This method of protective inoculation is now used with great success both as a protection, or prophylactic, when Diphtheria is prevalent, and as the best treatment for the disease itself.

Anti-Typhoid Inoculation.—This method of protective inoculation has been used extensively in our Army for some years past to lessen the risk of contracting Enteric Fever, before embarking for India and other foreign stations where the disease is still very prevalent and fatal, especially among young and recently-arrived officers and men. The vaccine used consists of a culture, or growth, of the organisms, or bacilli, which are *killed* previous to injection. The operation, which is free from danger, should be done twice at least, and has the power of giving the person so treated a partial protection against this disease for two years or so, and if he should contract the disease, of making it of a milder type than it otherwise might be. This method of treatment, namely, by protective inoculation, is unfortunately at present confined to a few

diseases only, the chief of which are Smallpox, Diphtheria, Hydrophobia (Rabies), Enteric Fever, Cholera and Plague.

In the case of Enteric Fever, this inoculation in the Army is quite voluntary, although strongly recommended. It must not be regarded by officers and men as a charm or talisman against this disease, as it only helps to increase the natural resistance of the individual. None of the sanitary precautions to be detailed must be omitted on the strength of supposed artificial immunity, or this form of treatment is likely to do more harm than good. (See Ch. IV., Enteric Fever.)

Isolation and Segregation.—In order to prevent the spread of infectious disease, it is necessary to separate the sick from the healthy by isolation, and this is carried out in hospitals, or quarters. In many cases it is also desirable for all persons who have been exposed to infection from the sick, or "contacts," as they are technically called, to be removed and segregated in a separate barrack-room, or quarter, and kept under daily observation until the time is passed during which they are likely to develop disease.

Disinfection.—This term means the process by which the organisms of infectious disease are *killed*, and it is carried out in several different ways, namely by :—

(1) Destruction of the infected material by fire.

(2) Dry heat, or baking in an oven.

(3) Moist heat (steam), or by boiling in water.

(4) Chemical solutions, such as cresol and carbolic acid, etc.

(5) Fumigation (sulphur).

(1) The use of fire for the destruction of infectious material in camp is simple and perfect. In a well-constructed destructor excreta can be burned, also clothing if necessary, and dry rubbish and refuse of all kinds can be easily disposed of.

This method is also very useful for disinfecting the ground surface, latrines, urinals, horse and mule lines, etc., by burning dry litter on the top. (See also Ch. VI., Destructors.)

(2) Dry heat is seldom used for clothing, etc., as it generally destroys fabrics if sufficiently hot to kill germs.

(3) Steam disinfection is the method now generally used when available for all articles which are not likely to be injured by this process, such as clothing, bedding, etc. On a case of infectious disease occurring in barracks, the man is first sent to hospital, and

then every article of his kit, public and private, including clothing, bedding, blankets, etc., is sent to the Military Hospital for disinfection (see Paras. 1002, 1081, K.R.). This is usually carried out by exposing articles like blankets, bedding, etc., for half-an-hour to steam heat in a special apparatus, such as Thresh's Disinfector, which is in charge of a trained staff. It is most important that the regimental authorities should see that every article is sent to be thus disinfected, as often articles like football kit, etc., are omitted.

(4) Other articles liable to damage from prolonged exposure to steam are disinfected either by soaking them for half-an-hour in a $2\frac{1}{2}$ per cent. solution of *cresol* in water or by spraying them with a solution of *formalin*, etc.

Disinfectants.—Chemical solutions used for killing germs are known as disinfectants. (See Ch. VI., Bedding.)

In special diseases such as Smallpox, infected articles of clothing, etc., are generally burnt. Disinfection of the barrack-room is carried out by the floor under the bed, and for six feet all round, also the bedstead, locker, or other articles

of furniture used by the sick person, being well scrubbed with the cresol solution. In the case of some diseases, the barrack-room, or quarter, is vacated and disinfected throughout before being again occupied. In camp, the same measures are carried out as far as practicable, in order to limit the spread of disease. Tents can be washed or soaked in disinfectant solutions, and the tent boards and poles washed with the same, while the ground surface can be burnt, or treated with the same chemicals. In the majority of the cases of infectious disease, infection is conveyed by the person on clothing and bedding, and not contracted from the walls, ceilings or fittings of buildings.

(5) *Fumigation by Sulphur.*—For the reason mentioned above, fumigation of rooms is not now considered of much practical use, and is seldom employed, except to kill mosquitos. It may be used when other methods of disinfection are either not suitable or not available. Articles of clothing, such as dyed tunics, boots, etc., which are usually ruined if put into a steam disinfector, may be exposed to the fumes of sulphur in a small confined space. Fumigation is carried out either by using the compressed gas,

sulphur dioxide, in 20-oz. cylinders, sufficient for each 1000 cubic feet of space, or by burning sulphur on a metal plate, (3lb. to each 1000 cubic feet of room space) over a bucket of boiling water, with the aid of methylated spirit poured over it, and then sealing up all apertures. In the first method, at the end of three hours the room should be re-opened and the sulphurous gas allowed to escape; in the second method, 24 hours should be allowed to pass before this is done.

Vermin in underclothing can be best destroyed by soaking for a few minutes in boiling water.

CHAPTER IV.

THE CHIEF PREVENTABLE DISEASES OF THE SOLDIER

1. **Enteric, or Typhoid Fever** as it is sometimes called, being the most important, will be described first.

Cause of Enteric Fever.—It is caused by a minute organism named the *bacillus typhosus*, which gets into the stomach and intestines by persons swallowing contaminated water, milk, or food, or living in insanitary and infected camps.

Distribution.—It occurs in almost all countries and amongst our troops, chiefly in India, South Africa, Ceylon, Egypt, Mauritius, and Bermuda, the type differing somewhat in different places. Our Army at home has less than that of any of the other great Powers, and less than the corresponding rate for civilian males.

Symptoms.—The disease comes on gradually and shows itself in weakness and fever, often associated with diarrhœa or constipation. It causes ulceration of part of the alimentary canal, or bowel, as its chief feature, and so is

named *enteric*. It lasts from three to five weeks, and convalescence is very slow. One attack does not absolutely protect against a second.

Spread of the Disease.—During the incubation period (see Ch. II.) and illness, and for some time after apparent recovery, the sick person gives off millions of enteric germs in his excreta (urine, fæces, and sweat), which are able to reproduce the disease in the body of any person whom they may enter under favourable conditions. One case of Enteric Fever may, in this way, by contamination of the water supply, cause an extensive epidemic. The disease has its origin in filth, and is spread by water, food, dust and flies, although the human body is the chief breeding-ground and storehouse of the germs. Mild cases frequently occur among men who do not feel ill enough to "report sick," but who all the time may be distributing the organisms broadcast to the danger of the rest of the community. Persons who have recovered from this disease may harbour the germs in their bodies for long periods, perhaps throughout life, without any knowledge of ill-health, and have been called "enteric carriers."

Sources of Infection.—Much controversy has taken place on this subject. The most common sources of infection are probably water, food, and the dust and flies of polluted camps, but

infected clothing, blankets, and bedding are very dangerous, especially when it is remembered how these articles are exposed to infection in barrack-rooms or camps at all times. (See Ch. VI., Bedding.)

Importance of Age.—Men under 25 years of age and newly arrived in a tropical country, like India, are the chief victims of this disease; so soldiers under 20 are not usually sent abroad, and they are not fit for foreign service "until at least 21 years of age." (Lord Roberts.)

The germs of this disease get into water and food supplies in many ways. At home, water is often infected by the excreta of an infected person getting into the water supply through a defective drain, cesspit, etc., especially in rural districts; in camp, by rain, dust or flies, conveying the disease from the latrines, where the infected material has been deposited, but not properly covered up with earth, or better with strong smelling chemical solutions usually called disinfectants.

Flies and Disease.—Much of this disease in India, South Africa, and America has been attributed to flies and contaminated dust. In South Africa, during the war, dead horses and other animals lying about the veldt and insanitary camps bred a plague of flies; camp tables and food became covered with them, and also the latrines as, in spite of all orders,

men neglected to properly cover up their excreta before leaving, not understanding the immense importance of this simple act, or being too lazy to do so. Flies alight on, breed in, and consume this filth, and then visit the cook-house, dining-tents, etc., or go for a drink to the water supply, and wherever they go they take with them the germs of Enteric Fever. If water or food so infected is swallowed by healthy men, a certain proportion of them, especially the younger ones, when their resistance to disease is lowered by foreign or active service, will be stricken down. This is how the disease spreads and leads to the paralysis of military operations, as occurred in South Africa for some time during 1900. The method of spread by latrines, dust, and flies, is not as much appreciated in England as with an Army abroad, especially during war. (See "*The Work of the Portland Hospital*," pp. 82 and 83. John Murray, 1901.)

Prevention of Enteric.—For the reasons given above, it is dangerous to drink water, as a rule abroad, and always on service, which has not been purified by boiling. Boiling is much safer than filtration. If there is no time for the water to get cold, make it into tea or coffee, which is the safest drink in war when clean water cannot as a rule be obtained, and even a cold infusion of tea is said to kill the germs of Enteric Fever.

No doubt the comparative immunity from this disease of the Russian and Japanese forces during the recent war is very largely explained by the simple habit of tea-drinking. An extra ration of tea and coffee was served out in South Africa to encourage this habit. The water-bottle filled over-night with boiling hot tea, keeps it clean and free from disease germs, and tea, with or without milk and sugar, is more stimulating and refreshing on the march than plain water.

F.S.R., Part I., S. 46 (4), states that "water-bottles must be frequently inspected by a medical officer," but as these articles form part of the men's fighting equipment, it is as necessary for every company officer to inspect these as it is for him to inspect rifles and ammunition. Preventable infectious disease kills more men in war than rifle bullets. (See Ch. I.)

All food, if sufficiently cooked and eaten hot, if otherwise of good quality, is safe, as cooking kills germs. Stored food must be protected from dust, flies, and other sources of possible contamination, and handled by clean persons. No person who has suffered from Enteric Fever, unless proved to be free from germs, should be employed in any kitchen or mess. Abroad, fresh milk must always be boiled, or good condensed milk used instead, as milk is one of the best fluids for the growth and multiplication of

disease germs, supplying them, as it does, with a *pabulum*, or food, in which they can thrive. In the Army, milk is used by the soldier to a very limited extent, but in civil life dairies are often the source of enteric infection, as of one epidemic which occurred in Dublin in 1899, where the owner of the dairy was himself suffering from Enteric Fever, and was nursed by his daughter, who also milked the cows!

Raw vegetables, as celery, salads, and water-cress, and shellfish, such as oysters, when eaten uncooked, are always dangerous. In this connection, butter and cream must also be remembered as possible sources of infection. Garrison dairies should, therefore, be carefully supervised and kept scrupulously clean.

In addition to these precautions, protective inoculation against this disease is strongly recommended. Personal cleanliness must be strictly supervised and insisted on, especially of all men having anything to do with the supply, handling, or distribution of food or drink in kitchens, messes, institutes, dairies, bakeries, mineral water factories, etc. Special attention should be paid to washing of hands, cleaning of finger-nails, and the wearing of clean and washable clothing, by preference white, by men employed in these duties. The consumption of bazaar food should be prohibited, and all

hawkers excluded from cantonments. (See also Ch. VII., *Personal Hygiene*.)

Enteric Fever and Filth Trenches.—In connection with the continued prevalence of Enteric Fever in India at the present time, and the common method of night-soil disposal in that country, it is worth noting that a study of this disease has shown "that stations where there are no filth trenches, or where they are a considerable distance from barracks, are, without exception, among those having a very low admission rate for this disease." The use of night-soil for manure by Government Grass Farms in India, supplying as they do British troops with dairy products, is open to grave objection from a sanitary point of view.

2. **Malarial Fever.**—This is generally known among the men as "Fever and Ague," and causes a great amount of inefficiency at foreign stations, especially the West Indies, South China, India, Burmah, Barbadoes, Mauritius, Straits Settlements, etc.

Repeated attacks of this disease are very debilitating, and cause much invaliding, and it ranks next to—if not above—Enteric Fever in Army importance. It is, as Manson says,* "directly or indirectly, the principal cause of morbidity and death in the tropics and sub-tropics."

* Tropical diseases.

The Cause of Malaria.—Malaria is caused by a minute organism, in appearance resembling the most primitive form of animal life known, the *amœba,* and so-called the *hæmamœba* (the blood *amœba*) or *plasmodium* of Malaria, which grows and develops in the red corpuscles of the blood. It was discovered by a Frenchman, named Laveran, in 1880.

Composition of Human Blood.—The human blood is composed of a colourless fluid or plasma, in which float, in addition to the less numerous *white* corpuscles, millions of microscopic discs of a reddish colour, each $\frac{1}{3500}$ of an inch in diameter, known as the red blood corpuscles, which give to the blood its red colour.

The Red Blood Corpuscles.—These carry the oxygen, taken into the lungs in breathing, by the arteries to all the tissues of the body. It is this life-giving oxygen that gives to the blood in the arteries its bright red colour. The red corpuscles also, on their return journey in the veins, remove the poisonous carbonic acid gas, the result of muscular work, and carry it to the lungs, where it is expired. They are sometimes spoken of as "oxygen carriers." (See Ch. VI.)

The Malarial parasite lives on and destroys these red corpuscles of the blood, and so produces the great pallor of the skin seen in people who have had much Malaria.

Types of Malaria.—At certain intervals, as a rule every 48 or 72 hours, each mature parasite produces from 10 to 20 young ones, or spores, as they are called, by a process of division, like the seeds of the higher plants. These young parasites are set free in the blood stream, and attack other red corpuscles. The different varieties of Malaria depend on the particular kind of parasite, or micro-organism of Malaria present in the blood, and on the length of time it takes to develop and set free its spores. Some forms of the disease, such as "Black Water Fever" of the West African coast, are much more severe than others, and often fatal.

Symptoms of Ague.—The ordinary attack of ague has been divided into three stages, a cold stage, a hot stage, and a sweating stage, and Defoe long ago, in "Robinson Crusoe," described the disease very well. It may be years before the person who has had Malaria badly is able to get the organism out of his blood and recover his health, and it is generally necessary to leave the tropical station to prevent fresh infection taking place, and to come to Europe, possibly to visit some well-known health resort, like Carlsbad.

How the Parasite Enters the Blood.—The infection of Malaria is only got in one way, namely, from the bite of an infected mosquito. If a person is suffering from Malaria—which

can generally be proved by finding the organism in a specimen of his blood under the microscope —and there are no mosquitoes in the place to carry the infection, he is unable to communicate the disease to other people, but, if mosquitoes of the species *Anopheles* are present in the immediate neighbourhood, he is very likely to be the unwilling cause of the disease being communicated to other people. This is how it occurs: The person suffering from an attack of Malarial Fever has the malarial organism in his blood, and on his being bitten by this species of mosquito, some of his blood containing the parasite is sucked up into the body of the insect. The malarial organism then undergoes a further development in the body of the mosquito, and this mosquito, in the act of sucking the blood of the next individual he comes across, introduces into this person's blood the parasite, now ready for mischief, at the same time.

Difference between Anopheles and Culex Mosquitoes. — The malaria-carrying mosquito may generally be recognised by its smaller size, darker colour, by often having brown spots on the anterior edge of the wings, and from the fact that, when standing on a wall the head is pointed downwards more or less at right angles to the surface, while the more common and harmless mosquito, of the species named *Culex*, rests

more or less with the axis of the body parallel to the surface.

Life of the Mosquito.—The mosquito, like many other flying insects, passes through four changes, or metamorphosis, in its life history, namely, eggs, larval and pupa stages, and finally the perfect insect. The eggs of the common species of mosquito (*Culex*) are laid in boat-shaped masses on the surface of *artificial* collections of water about houses, and to the naked eye look like specks of soot. In a few days these eggs hatch out into larvæ, which can generally be seen in almost any standing water, such as in cisterns, fire buckets, etc., in tropical countries, and in Europe, in summer time. In shape they somewhat resemble the small fish called the gudgeon, and when fully grown are about a quarter of an inch in length, with a large head, jointed body and no feet. The smaller tail end is divided into two, and they breathe at the surface of the water through one of these divisions, with the head downwards. When disturbed they immediately sink to the bottom. When at the surface of the water breathing, they also feed, at other times they wriggle about, their food being composed of minute animal matter in the water, which is usually stagnant. They also eat each other. Small fish, like gold fish, are their deadliest enemies, and will soon exterminate them if introduced

into ponds. In a week or ten days the larvæ changes into the pupa form, and somewhat resembles a minute shrimp, moving about in the water by a series of jerks, by rapidly coiling up and uncoiling its body. It does not feed, and in three or four days more the perfect mosquito emerges from the skin of the pupa. All these stages, etc., may be easily watched by catching a female mosquito—which alone sucks blood—the male being a vegetarian—dozing on the inside of the mosquito curtain after a successful night's work, where it may be recognised by its black swollen body, putting it into a wineglass with a little water at the bottom, and covering the mouth of the glass with fine gauze or some cotton wool. A magnifying glass will assist the study.

Prevention of Malaria.—It will now be easily understood what steps are necessary to prevent this disease.

(1) Try to destroy all eggs and larvæ, etc., of mosquitoes in all collections of shallow water about houses by pouring a small quantity of Kerosine oil (about 1 oz. to 16 square feet of surface) on the surface of the water. This makes a scum, and, by preventing the larvæ from breathing, kills them. It also kills the eggs, and stops mosquitoes laying any more.

(2) Fill up all rainwater puddles in the vicinity of barracks and quarters, make channels

for the rainwater to get away, or soak into the earth (drainage) ; leave no empty tins, bottles, etc., about to collect rainwater ; cover all rain-water tanks and cisterns with fine wire or gauze netting, to prevent mosquitoes laying their eggs on the water, and to imprison any that may subsequently develop ; clear away all rank vegetation, and allow air and sunlight to have free play.

In ponds used for watering animals, etc., where the above methods are not suitable or practicable, introduce small hardy country fish to do the killing. This last method is of great importance, as unfortunately the *Anopheles* mosquito frequently breeds in *natural* collections of water, such as small sluggish streams, paddy-fields, etc., and its larvæ feed on vegetable matter in the water (algæ).

(3) *Use Mosquito Curtains* and " punkahs " to ward off the bites of mosquitoes and other blood-sucking insects, many of which carry disease. Keep the house well dusted and free from unnecessary curtains, which harbour mosquitoes.

Especially prevent mosquitoes biting persons suffering from Malarial Fever. It has been noticed that married men and N.C.O.'s in separate bunks, who generally use curtains, do not suffer from this disease as much as men in barrack-rooms. Curtains of an improved

pattern are now issued in India and other tropical stations more generally than was formerly the case, and the prejudice against them should gradually disappear when the men understand their importance better. The Russians and Japanese in Manchuria are said to have netted the windows and doors of houses, and also the exposed parts of the body (face and hands) when mosquitoes and flies were numerous.

(4) *Quinine* should be used as a preventative in malarious districts, as this drug has the power in many cases of killing the *plasmodium* in the blood when taken in doses of 5 grains daily, or 10 grains twice a week, for several weeks; all persons who have recently had an attack of Malaria should continue this treatment for some time after their discharge from the sick-list. All men suffering from fever should be made to "report sick" at once, and not be allowed to spend the afternoon in the barrack-room "sleeping it off," as they frequently do. This is a danger to the other occupants of the room.

European troops should live as far away as possible from natives, who are great sufferers from this disease, bazaars and servants' quarters in India being as a rule much too close to barracks and bungalows. In convalescence over exertion, chills, wettings and exposure of all kinds should be carefully avoided. The

Americans have had great success with these methods of attacking Malaria in Panama, the Phillipines, etc., and England, although slow to move, led by Major Sir Ronald Ross, K.C.B., F.R.S., who discovered in 1897 the part played by the mosquito in the conveyance of the disease from man to man—has done much in India, Ismailia, West Africa and other places.

(3) **Dysentery.**—This disease has always been a scourge to armies in the field. In the Peninsula, Crimea, Egypt and the Soudan it caused great havoc, and in South Africa accounted for 31,000 admissions to hospital during the war. It is endemic, or always present, in many tropical and sub-tropical countries.

Symptoms.—It comes on suddenly, with severe griping pains in the abdomen, a constant desire to go to stool, when small quantities of blood and slime are passed from the bowel with much straining.

Cause of the Disease.—It is caused by the entrance into the body of the specific organisms, which attack the lining membrane of the lower part of the bowel or intestine, setting up inflammation, leading to ulceration. Two forms of this disease are described, one caused by an animal organism named the *Amœba coli*, and the other by bacilli. Very often an attack of Dysentery is preceded by Diarrhœa for a few days. The disease may last for a week

or so, or much longer, and relapses are common. One attack does not protect against another, but predisposes to it. Occasionally the illness becomes chronic, and may last for years. Dysentery has a great tendency to cause liver troubles, such as abscess of the liver, at a later date.

Source of Infection.—These are similar to those given under Enteric Fever generally, especially soil pollution in camp. Cold and damp, chills, etc., render one more liable to contract the disease, and should therefore be carefully avoided if possible. When living in camp or bivouac, hot days followed by cold nights are trying to the health, especially if using preserved rations and badly-cooked food, which puts the stomach out of order. (See Ch. VII., *Cooking*.)

Prevention of Dysentery.—The methods of preventing this disease are exactly the same as those given under Enteric Fever, and include special attention being devoted to the cleanliness of all camps, and the supervision of water and food supplies. In South Africa this disease was always closely associated with Enteric Fever, and the infection is in the habit of remaining in a camping-ground for a very long period. If much Dysentery is present among the men in a camp, if possible a change should be made to a fresh site, and fresh provisions

issued instead of preserved meat and vegetables. The sick should be separated at once from the healthy, and all their discharges burnt, or deeply buried outside the perimeter of the camp, with the addition of some disinfectant, like carbolic acid, and the place marked.

As a general rule, the use of boiled water for drinking purposes, the avoidance of unwholesome and insufficiently cooked food, the wearing of flannel underclothing with a "Cholera belt" at night, and keeping all camps in a perfect sanitary condition will do much to ward off this troublesome and common disease on field service.

(4) **Diarrhœa.**—This is a common complaint on service. In ordinary cases it is not a disease, but only a symptom that some food has been found irritating to the inside, and that the bowel is attempting to get rid of it. This should be helped by a dose of some simple aperient medicine, and "*stoppers*" should not be taken, as is very often done. Occasionally, Diarrhœa occurs in epidemic form—quite a serious matter—due to some general poisoning by food or drink, and may cause much loss of efficiency, if not loss of life.

Diarrhœa is also a common symptom of the beginning of several diseases, such as Enteric Fever, Dysentery and Cholera, and as such must be taken in hand early and treated. As this

may be a danger signal, men should be made to "report sick" at once by their non-commissioned officers.

Diarrhœa is often regarded by the men as of little or no importance, and is especially common among soldiers serving abroad. It is to be chiefly attributed to large, hurriedly eaten meals, imperfectly masticated, containing an excessive proportion of meat, which cannot be properly digested by the stomach and bowels.

The habit of opening canteens shortly before the dinner hour is generally condemned, as it encourages the drinking of a large amount of cold fluid before meals, and not a smaller amount with, or after food, which is more in accordance with the teachings of human physiology. The former practice, which is nearly universal, interferes with the natural process of digestion, and is likely to produce Diarrhœa.

(5) **Constipation.**—Inattention to a regular daily action of the bowels, though not usually called a disease, is no doubt responsible for much disease in the Army, as in civil life. The "absent-minded beggar," as the soldier has been described, is very careless with regard to this matter, and appears to follow no fixed rule or habit. Many men suffer from this complaint in spite of taking plenty of exercise. A weekly dose of some simple, harmless aperient, like Epsom Salts or Castor Oil, would no doubt

do much to prevent infection by Enteric Fever, attacks of Appendicitis and other abdominal troubles so common at home and abroad. The cleanliness of the *inside* of the body is probably of more importance to health than even the cleanliness of the outside, and bacteria must not be allowed to accumulate there and attack its delicate lining membrane, producing all sorts of diseases, as they have been shown to do. The late General Gordon considered that aperient pills were almost the only medicines necessary in the Soudan, as he expressed it, "to keep the line of communications open," and the name of David Livingstone, in Central Africa, has been associated with medicines used for a similar purpose.

(6) **Cholera.**—This disease was formerly very common among British troops in India (the home of Cholera), but at the present day, owing to greater care in providing pure water supplies in cantonments and to Army sanitation generally, it is almost confined to the native population.

Distribution.—Its endemic home is the valley of the Ganges, but terrible epidemics have formerly occurred in this country, notably in 1854, and in other parts of Europe, the disease being carried from India along the trade routes by dirty pilgrims and merchant caravans. In the Crimea (1854-5) it killed 10,000 British and

French troops. There is nothing mysterious about this disease which, like others of the same class, is the direct outcome of filth due to neglect of sanitation.

Symptoms.—This disease takes from a few hours to a few days (3 to 10) to develop, the actual attack beginning with violent diarrhœa and vomiting. The stools passed from the bowels have been likened in appearance to the water in which rice has been boiled ("rice-water stools"). The great and rapid loss of water from the blood due to this incessant vomiting and purging causes the body to become dried up, and produces intense thirst. The person attacked suffers also from severe muscular cramps in the body and legs, and soon becomes very blue, cold and collapsed.

Cause of the Disease.—Cholera is caused by the entrance into the body of a micro-organism, in shape like the comma (,) used in writing, and known by the name of the "comma bacillus" of Koch, after the distinguished German scientist, who, in 1884, first proved that it was the cause of this disease.

Source of Infection.—The organism generally enters the body through the medium of drinking water, and attacks principally the lining membrane of the stomach and intestines, causing the chief symptoms—namely, vomiting and purging. The habit of the natives of India of

washing clothes in all rivers and tanks, and also attending to certain bodily ablutions in the early morning at the river bank, or beside the village well, is responsible for the continued presence of this organism in the waters of the "holy Ganges" and in other rivers and sources of drinking water supply in India.

Predisposing Causes.—Persons with their internal economy out of order, and suffering from diarrhœa or indigestion, especially if worrying about and frightened of this disease in times of epidemics, are the most likely to fall victims to it, as their digestive juices (the gastric juice in particular) are altered in composition and unable to destroy the organisms which may have been swallowed. (See Ch. II., *Susceptibility to Disease.*)

Methods of Prevention.—The general methods required to prevent this disease are the same as mentioned under Enteric Fever and Dysentery, and need not be repeated. Special attention must be devoted to water and food supplies of every kind, especially the former, as the disease is generally spread by water, but all other sanitary precautions are necessary. The sick and their attendants must be isolated, and infected houses, clothing or discharges disinfected or burnt.

As the infection of the water supply at its source, or in its distribution, has generally

been proved to be the cause of an outbreak, a new water supply should, if possible, be selected and everything used in connection with the collection, purification, or distribution of the old one abandoned. All water-tanks, buckets, filters, water-bottles, etc., should be either destroyed or thoroughly sterilised with boiling water, to which some dilute sulphuric acid has first been added. When several cases of Cholera have occurred in a cantonment or camp the unaffected troops are generally marched into a new camp, or "Cholera camp," leaving everything behind that could possibly carry the disease, as moving from camp to camp is in itself no use unless this is attended to. At Lucknow, in 1894, a serious epidemic of this disease broke out among the men of the 1st Battalion, East Lancashire Regiment, who were moved out into Cholera camp, and from camp to camp, but fresh cases of the disease continued to occur for some days as the *Macnamara* filters, some of which were infected, had been taken with the troops from Lucknow. In the Tropics, overeating and indigestible food must at all times be shunned, also the use of uncooked vegetables, unripe and overripe fruit. Excess in alcohol, or in food or drink liable to upset the stomach, when Cholera is prevalent, is especially dangerous. Chills must be avoided by wearing proper flannel underclothing, by taking hot

instead of cold baths, by changing clothes at once after exercise, and by keeping the abdomen in particular properly protected at night by the use of a "Cholera-belt" when sleeping under a punkah. The abdomen, or stomach, is the most vital part of the body in the Tropics, and the part that most easily gets out of order.

Protective Inoculation.—This form of protective treatment against Cholera has been tried in India with uncertain results.

(7) **Yellow Fever.**—In the past this fever, the "Yellow Jack" of sailors, has been a terrible disease in the West Indies, the Brazils, West Coast of Africa, etc., and is still endemic in many parts of the West Indies and South America. Occasionally it has been imported into Europe, but has not so far been carried to the Continent of Asia. In 1802 the French Expedition to San Domingo lost 50,000 out of 58,000 men in four months from this disease. To develop in epidemic form Yellow Fever requires an average air temperature of 75° F., and so it has never obtained a permanent foothold in Europe.

Cause of the Disease.—It is caused by the infection of the blood by a minute animal germ, which is carried from the sick to the healthy (in the same way as Malaria) by the agency of a species of mosquito, which has been identified and is known by the name of *Stegomyia.*

By destroying this insect, its breeding places, and by protecting persons from its bites, combined with general measures of sanitation, the town of Havana, the capital of Cuba, is now for the first time in its history free from Yellow Fever. The same may also be said of Jamaica.

(8) **Plague.**—In the Middle Ages this disease or something very similar, devastated many countries in Europe, including our own, in the form of epidemics. It is impossible to say if the Great Plague of London in 1664-5 was the same as that now known as Oriental Plague, but the white race is certainly liable to infection. In those two years upwards of 70,000 perished of the 460,000 inhabitants of the London of that day.

Plague is now commonly met with in China, India, parts of Africa, and recently in South America, Mauritius and even in Australia. In 1894 it attacked our colony of Hong Kong, and last winter (1910-11) a severe epidemic occurred in North China, with a death-rate of about 90 per cent.

Predisposing Causes.—These are filth and overcrowding, conditions generally present among Oriental populations.

The Specific Cause of Plague is the "bacillus pestis," first discovered by the Japanese pathologist, Kitasato, during the Hong Kong epidemic of 1894.

There are two types of the disease, one called " Bubonic " Plague, which causes glandular swellings in the groin and armpits, and " Pneumonic " Plague, like pneumonia, chiefly affecting the lungs, which is even more fatal.

Protective Inoculation.—This treatment has been extensively tried in India against this disease with uncertain results.

Rats and Plague.—It has been found that rats suffer from this disease first, and that the infection is carried to man by the fleas, etc., of plague-stricken rats. The death of rats from Plague is therefore a danger signal, and in addition to all ordinary measures of sanitation, the destruction of rats is now regarded as important. Their bodies should be burnt. The presence of the plague bacillus in certain areas in the East of England and in the Port of London this year (1911) deserves attention. Quite apart from disease, it has been recently stated by the Secretary of the Associated Chambers of Agriculture that rats in England do £15,000,000 worth of damage to the crops each year.

An international Medical Conference was held recently in Peking, by the invitation of the Chinese Government, to discuss the best methods for limiting the spread of this terrible disease.

(9) **Typhus Fever.**—This disease, which until about sixty years ago, was not distinguished from Enteric Fever, is highly infectious, and was

formerly under the names of "*Camp*," "*Jail*" and "*Spotted*" fever, one of the most dangerous enemies which an Army had to encounter in temperate and cold climates. The Russians, after the Battle of Plevna, in the Russo-Turkish War of 1877-8, lost 60,000 out of a strength of 120,000 men by this disease. Typhus Fever is now very rare in the British Isles, and only occurs as a rule among the poor population of large cities, and during peace, among troops in South-Eastern Europe.

Predisposing Causes.—These are filth, overcrowding and famine; the supply of sufficient food and general sanitary measures prevents its outbreak.

Exciting Cause.—The micro-organism which causes this disease has not been discovered.

Spread of Infection.—The poison is conveyed by clothes and other similar articles, but does not appear to be carried by water, milk or food.

(10) **Malta Fever.**—For many years this disease has crippled many officers and men of both Services, at Malta and other Mediterranean stations chiefly.

Symptoms.—The symptoms of this disease (which is quite distinct from Enteric Fever) are mainly a fever which continues a long time, with pains in the joints, somewhat resembling Rheumatism.

Cause of the Disease.—The cause of Malta

Fever is a special micrococcus, discovered in 1887 by an officer of the R.A.M.C., Captain, now Colonel Sir David Bruce, C.B., F.R.S. This organism, in addition to being found in the bodies of persons suffering from the disease, has also been found in goats and in their milk. As goats' milk is the chief milk supply on the Mediterranean coast, the spread of the disease is explained.

Prevention.—Goats and goats' milk are now prohibited in barracks at Malta, and the result is that whereas Malta Fever caused 643 admissions to hospital in 1905, it has now practically ceased to exist. The case of this disease may be cited as one of the most noteworthy triumphs of the science of bacteriology known with regard to disease prevention.

(11) **Scurvy.**—In Chapter I. it is stated that this disease has now practically disappeared in the British Navy and Mercantile Marine, where it was formerly very common, and the same may be said of its occurrence among British troops under peace conditions on land and sea. In the South African War, as the result of sieges, like Ladysmith, and of the use for long periods of preserved rations on the march, it occurred to a certain extent. In the last Somaliland expedition it was prevalent among Indian and African troops. At Port Arthur, among the Russian garrison, it caused great havoc, and

helped to force the capitulation of the 1st January, 1905. According to the Official Report, four weeks after this, the number of the sick and wounded in the hospitals of Port Arthur was 11,478, of whom 6,278 were cases of Scurvy.

In the Crimea, it is stated that the Turkish Army was nearly destroyed by it, and that the British Army had over 17,000 cases of this disease.

Cause of Scurvy.—No special micro-organism has been found, but the disease is caused by an absence of fresh meat and vegetables from the daily ration of the soldier, often a necessary condition in war. It is predisposed to by all the factors mentioned in Chapter II., under *Causes which Lower Resistance.* It is not infectious in any sense.

Prevention.—Scurvy may be prevented by the issue of fresh meat, fruit (especially lemons, limes, oranges and grapes) and vegetables (especially potatoes, onions and tomatoes). When fresh vegetables cannot be obtained, as often on field service and sometimes on board ship, lime juice with sugar is issued. Lime juice was first used for the prevention of scurvy by Captain Cook during his voyages round the world. Vinegar is useful as a preventative under the same conditions, either used in the cooking of preserved provisions or in the form of pickles. (See also Para. 1624 K.R., Para 27, All. Regs., and Ch. VII., *Field Service Regulations.*)

(12) **Tuberculosis.**—This disease, commonly called Consumption when it affects the lungs, but which also attacks the brain, bones, joints and glands of the body, causes more deaths in the British Isles than any three other diseases put together.

Predisposing Causes.—These are over-crowding and want of ventilation, hereditary weakness of the chest, as shown by the want of normal chest capacity on measurement in the recruit, the want of proper nourishment, certain occupations, exposure to damp and chills, etc. The young are more easily infected. The disease attacks all classes, and although occurring in all countries and climates, tropical service has been shown to favour its development.

Exciting Cause.—The actual cause of this disease is the "bacillus tuberculosis" discovered by Koch in 1882, which is found in the parts of the body affected, and is contained in the sputa of persons suffering from tubercle of the lungs in great numbers. This organism is able to retain its vitality for a long time in the dust of rooms, and is difficult to kill. It probably enters the body through the lungs in the act of breathing, but infection may also occur by eating the insufficiently cooked meat of tuberculous animals, or by drinking the milk of infected cows. Milk is a common source of

infection with young children, whose food supply is mainly in this form.

Prevention.—This consists in counteracting as far as possible all predisposing causes by attention to hygiene, of which the provision of plenty of fresh air and good food are the most important.

The separation of the sick from the healthy in special hospitals, or homes, is necessary, as with other infectious diseases. The danger of infection in barrack-rooms is considerable. This disease formerly caused much mortality and invaliding in our Army, but during the last fifty years, by the provision of more cubic and floor space to each man in barracks, and by better food, clothing and a general improvement all round in the conditions of service, this mortality and invaliding has been very much reduced. (See Ch. VI., *Ventilation in Barracks.*)

Spitting on the floors of barrack-rooms and in the precincts of barracks should be prohibited, as in addition to being a dirty, it is a dangerous habit, and still much too common. Railway companies and other public bodies have already recognised this, and made spitting in carriages and on platforms a punishable offence.

The *Open-Air Treatment* of this disease simply means living and sleeping as much as possible in the fresh air. Exposure to changes of weather is less harmful, even in the English

climate, than constantly breathing the impure and often infected air of stuffy work-rooms, offices, or barrack-rooms (see Para. 1003 K.R.). Many persons who open the windows of their sleeping-rooms most carefully every morning shut them up at night, under the impression that night air is dangerous. The important time to have windows open (ventilation) is when the rooms are occupied.

(13) **Venereal Diseases.**—These diseases are prevalent in the Army, as in civil life, and cause much loss of efficiency. It is satisfactory to note that, like intemperance, they are gradually diminishing year by year. No man undergoing treatment for venereal diseases can be considered fit for service (see Art. 999, Pay Warrant). In recent years a more systematic notification and treatment has been adopted throughout the Army, and the soldier who is unfortunate enough to contract these diseases during his colour service is now probably better treated and looked after in every way than his brother in civil life under the same conditions.

Cause.—The special organisms which produce the infection in Gonorrhœa and Syphilis have now been identified and, from a "sanitary" point of view, these diseases can, like many others, to a large extent, be prevented by attention to personal cleanliness and the use of certain disinfectants, etc. Para. 462 K.R., should be carefully noted and carried out in all units.

CHAPTER V

WATER SUPPLIES

In connection with water supplies, see also K.R. 1908, Para. 1037 and 1625; F.S. Regs., Part I., 1909, S., 57; F.S., Regs., Part II., 1909, S.S., 70 to 72; F.S. Pocket Book, 1908, pp. 39 to 41; Manual of Field Engineering, 1911, S.S., 61 to 63.

As the health of a field force largely depends on the proper selection and protection of water supplies, this subject forms the most important part of Military Hygiene. It is usually found that if water supplies are carefully supervised, other possible sources of danger to the health of the troops are at the same time guarded against. In addition to protecting the source of supply, water when purified must be kept from subsequent contamination, and men must be prevented from drinking any water that has not been so purified. If this is not well attended to, all the trouble will have been taken in vain. One of our military attachés with the Japanese Army in Manchuria states in a Report: "I think that the extra-

ordinary absence of sickness in this Army is largely due to the fact that there have been none of the usual campaigning difficulties with regard to water."

The subject of water supplies, with special reference to field service, will be considered as regards their (1) *Source*, (2) *Protection*, (3) *Purification*, and (4) *Distribution*, as in barracks and at camps on manœuvres water is generally laid on.

Source of Water.—All water is indirectly derived from rivers, lakes, springs, wells, ponds, etc., or directly from the rainfall and stored in tanks, and occasionally by distillation of sea water, as at Suakim during the Egyptian War of 1884-5. One-third of the total rainfall sinks into the ground, one-third is evaporated, and one-third flows off into rivers, lakes, the sea, etc.

The Tactical Importance of Water Supply.—In the presence of the enemy, tactical considerations are always of the first importance, but a good water supply is essential, and considerations of safety may necessitate a camp or bivouac being placed at some distance from it. The cutting off of an enemy's water supply is frequently attempted in war, and Bloemfontein, Ladysmith and Port Arthur are recent examples. The Boers captured the waterworks at the former place and held them for nearly a month, until the 22nd April, 1900; the water

supply for the troops during this time was limited to the "Bloemfontein Spring" and a few wells and dams. It was here that the worst epidemic of Enteric Fever during the war occurred shortly afterwards. Blowing up springs with a charge of dynamite in order to divert the supply of water from them has even been tried in war, and it must not be forgotten that in savage warfare water supplies may be intentionally poisoned.

The absence of a suitable water supply is said to have compelled General Buller to abandon the relief of Ladysmith after the successful Battle of Val Krantz, and Wellington is believed to have changed his position at the Battle of Vimiera almost at the moment of the French attack on account of water supply. Sometimes, especially in hot countries, the very existence of an Army may depend on an adequate supply of water. This is well illustrated by the experience of the Indian Mutiny, and Lord Roberts in his book, "Forty-one Years in India," has described how the 9th Lancers showed their appreciation of the heroism of the Indian *bhistie* on the Ridge at Delhi during the summer of 1857.* Kipling† has also sung

* When the troopers of the 9th Lancers were called upon to name the man they considered most worthy of the Victoria Cross they unanimously chose the head *bhistie*.

† "Barrack Room Ballads, and other verses."

the praises of the *bhistie,* or Indian water-carrier.

Ground Water.—When the rainwater which sinks into the ground meets with a stratum, like clay, which it cannot pass through, it collects and is then known as the "ground water." This ground water is not stagnant as a rule, but, like a slow underground stream, constantly on the move. Its depth below the surface depends on the depth of the waterproof stratum on which it lies, and this may be easily proved by taking the different levels of water standing in shallow wells by measuring from the surface of the ground.

Shallow Wells.—These (usually under 100 feet in depth) simply tap the ground water which has passed through the surface layers of the ground. They are unsatisfactory, because in times of drought they are apt to dry up, and also from the fact that all the organic impurities (matter derived from animals and plants) of the soil through which the water passes are carried into them. They are therefore to be considered "very suspicious" as a source of water supply, and may also contain leakage from cesspools, privies, stables, pigsties, etc., or any other surface or ground contamination, especially after rain. It should be remembered on manœuvres that the rural districts in England are still chiefly supplied by these wells.

Shallow wells abound in India and other tropical countries, where the native population is chiefly supplied from them, and wholesale poisoning with Cholera, etc., is not uncommon. The clergyman at home who supplied his household with water from the well situated in the centre of the churchyard was evidently trusting too much in Providence.

Deep Wells.—These are, technically, wells over 100 feet in depth, or which tap water lying *below* a waterproof stratum which protects the water in them from surface pollution. They are usually "very safe," as the water has been thoroughly filtered in its passage through a considerable depth of earth or rock.

Artesian Wells are one variety of deep wells sunk by boring and tap water at a great depth below the ground surface, often in rock cavities, etc.

Springs.—This is the name given to water which makes its appearance spontaneously at the surface of the ground. They are of two kinds, surface and deep-seated springs.

Surface Springs.—These are produced when the ground water, after passing through a porous stratum, such as sand, arrives at an impervious or waterproof stratum *such as clay*; it will then flow along this till it issues as a spring where the clay comes to the surface on the side of a hill, or as a general line of wetness.

Deep Springs.—These are supplied by water which may have fallen as rain at a considerable distance, and travelled along a circuitous course, following joints and faults in the underlying strata and eventually rising as springs.

Spring waters are as a rule safe to drink, as they have gone through a natural process of filtration. In the case of surface springs, any sources of impurity in the immediate neighbourhood should be looked for. The deeper the spring the purer the water. The supply of water from springs varies, and the flow may be measured by receiving the water into a vessel of known capacity and timing the rate of filling. Spring water is often "very hard," that is to say, it contains much mineral matter, such as lime (carbonate of calcium), which it has dissolved in its passage through the ground, and, if from a great depth, is frequently very cold. Occasionally spring water may be warm, or even hot, as the water of many thermal springs noted for their medicinal virtues, which is of course not suitable for ordinary drinking purposes. Water has often to be searched for on service by borings at the foot of hills, in dry river beds ("nullahs"), or at low levels on the plain, especially where there are any traces of vegetation, *Norton's Tube* wells being used, as in many of the standing camps in South Africa.

Rainwater.—On a large scale rainwater is caught in reservoirs and run into service tanks, as in South Africa generally, or, from roofs of houses, as at Gibraltar and Bermuda, and afterwards purified. Rainwater, if fresh and caught direct in clean vessels, is safe to drink.

Lakes.—The water of large fresh lakes, especially those containing clear water and with firm, rocky bottoms, is usually safe to drink if taken well away from dwellings. The water supply of Glasgow is derived from Loch Katrine, and Manchester is supplied from Thirlmere.

Rivers.—The water from rivers is generally suspicious. Towards the source, as in mountain torrents, it is comparatively pure, in the valley and plain it is open to much contamination, and will require purification. London is partly supplied with water from the Rivers Thames and Lee, which is purified by filtration through deep beds of sand and gravel before distribution. River water varies much with season, flood time, drought, etc., the purest water being that taken from mid-stream.

Order of Purity.—The various sources of water may be arranged in the following order of purity :—

1.	Artesian Wells	perfectly safe.
2.	Deep Wells ... ... / Deep Springs	very ,,

3.	Surface, or Land Springs	usually safe.
4.	Rainwater (fresh) ...	safe.
5.	Lakes	usually safe.
6.	Rivers	suspicious.
7.	Surface Collections ... / Shallow Wells	very suspicious.

Transport of Water.—Water is usually procured locally, or brought into camp in pipes, sometimes it has to be carried for a considerable distance, and its transport may be very costly. During the Egyptian War of 1884-5 the force which marched from Suakim to Hasheen across the desert required 13,000 gallons of water, carried on 700 camels. Each camel carried two 12 and one ½-gallon tank, which, exclusive of the saddle, weighed 316 lbs. One gallon of water weighs about 10 lbs, and 1 cubic foot of water=6¼ gallons, and on this basis estimates may be made. In the South African War it is stated that all drinking water required by the troops at Frere and Chieveley had to be brought by train in water-tanks from down country, and at the Battle of Colenso these water-trucks supplied the troops with water on the battlefield.

Amount of Water Required.—One gallon per man per diem is sufficient for drinking and cooking purposes. A horse, bullock, or mule drinks about 1½ gallons at a time. In standing

camps an average allowance of 5 gallons should be given for a man, and 10 gallons for a horse or camel. An elephant drinks 25 gallons, each mule or ox drinks 6 to 8 gallons, each sheep or pig 6 to 8 pints. Each horse should be allowed five minutes at the trough, and four feet of lateral space. These are minimum quantities. The method of measuring the average yield of a stream is given in F.S. Pocket Book, p. 39. See also p. 98, D., and M.F. Eng., S. 61 (2).

Selection and Protection of Supplies.—The water supply will always be selected in conjunction with the sanitary or other medical officer, who will satisfy himself as to its fitness for use. This is not always easy or even possible to do, a rough analysis is generally made, and the best available supply selected. When the inhabitants are friendly, much useful information may be obtained from them, but this should always be accepted with caution. On service this selection of the water supply is done in advance of troops, as far as possible at the time when camping-grounds are chosen by a staff officer in conjunction with a medical officer. As a rule the military police, or the first troops to arrive at a halting ground, are ordered to mount sentries on all water likely to be required for use, with such orders as will prevent any form of pollution. These sentries will not be

withdrawn until permanent water guards are detailed.

Watering-places may be detailed by the staff for the common use of all units, or separate arrangements made for each administrative district ; in any case, the officer commanding is responsible that due precautions are taken.

Water from River or Stream.—If water is obtained from a stream, horses will be watered below the place where troops obtain their drinking water, but above bathing and washing places. Patrolling by mounted men will often be necessary for some distance above the spot selected for the drinking water supply. It should never be forgotten that other bodies of troops may be encamped near the same river or stream lower down, and so no fouling of the water must be allowed. The water supply and the way to reach it must be clearly marked. This is usually done with flags by the advanced party of engineers, *white* being used for drinking water for men, *blue* for animals, and *red* for washing or bathing places ; but, it is better, for the reason mentioned above, that no washing of clothes should be allowed in the river itself, and that animals should be watered by trough if possible. In standing camps, it is advisable to have the water brought into camp in pipes, as carts and fatigue parties constantly drawing water soon render the neighbourhood of a

stream, etc., very foul. If this is not practicable, the approaches to the river, etc., should be roughly paved with stones and drained for a width of 10 feet, and all water drawn from mid stream with a "lift and force pump," fitted with flexible suction hose, troughs being provided for animals. See M.F. Eng., SS., 61 and 62.

Dipping.—No "dipping" must be allowed, as is common, or individuals supplying their own or company requirements by the aid of dirty camp kettles, water-bottles, empty tins or other handy articles, as this is certain to lead to contamination.

All water for drinking and cooking purposes should be drawn by the specially detailed "water party," and by these men only. They are provided at present from the ranks of the R.A.M.C., and their number for each unit will be found in War Establishments. (See Ch. VII.)

Water from Wells.—In the case of wells, those should be selected which are at the highest level (not below the camp), in best repair, lined with brickwork or masonry, raised above the ground level by a "coping," and provided with a cover. The flexible hose pipe should pass through an opening in the cover, and only the pumping party allowed near the well. The ground around should be cleared and roughly paved with stones, bricks, brushwood, etc.,

and drained into a soakage-pit to prevent it getting sloppy. In hot and dusty climates it is advisable to cover in the well completely by building over it a straw hut, with a door, to be furnished with a padlock and key. The latter to be in charge of the water party (see plate 5 F.S. Pocket Book). Before being used all wells, if time permits, should first be pumped out, then cleaned out, with or without the addition of a solution of permanganate of potash, and allowed to refill and settle before use, as dead animals, etc., are sometimes found at the bottom. Permanganate of potash removes offensive smell from water and to some extent oxidizes dissolved organic matter.

If running water is not available for the supply of a camp, the well, spring, etc., must be very strictly protected, a rough barbed wire fence, or some other form of fencing, being placed round it to keep animals out. In this case all animals must be watered by trough, bucket or nosebag. Washing should be allowed only at some distance from the water supply, empty biscuit tins, or other receptacles, being used to draw water for this purpose.

Characters of Good Water.—Whatever water is selected for the supply of troops should be the best available. It should, if possible, be clear, cold, free from unpleasant smell or taste, but all water on service will require purification

before use. The neighbourhood of houses, manured fields and other sources of contamination must be avoided in making a selection.

Methods of Straining Water.—All water, if muddy, before being purified (sterilised) for use must first be strained to clear it of suspended matters (animal, vegetable and mineral). The following methods are recommended in the F.S. Pocket Book, p. 41.

(*a*) Add alum, 6 grains to gallon, stir and allow to settle.

(*b*) Tack a sheet on to a wooden frame so as to form a bag or basin ; put a couple of handfuls of wood ashes, and then pour on the water, placing a receptacle beneath to catch the water which percolates through. A sheet will be difficult to find on service, but a clean blanket or piece of tent cloth will do as well.

(*c*) Take two casks and place one inside the other, the outer pierced with holes at the bottom, and the inner near the top ; the space between is filled with sand, or gravel or wood charcoal ; when these are placed in a stream, the water rises through the filtering material between the barrels, and flows into the inner one.

In method (*a*), 6 grains of permanganate of

potash to the gallon of water, in addition to the alum, will give a better result.

How To Make Charcoal.—Dig a hole about 5 feet diameter and 3 feet deep, fill with wood, set the whole alight, then cover over the top with earth so as to exclude the embers from contact with the air. Leave it untouched for 24 hours before opening.

A stretched tarpaulin can be used to pump or empty the water into, and the mud will settle to the bottom.

Protection of Storing Tanks.—Vessels or tanks in which drinking water is stored, as well as being carefully covered and ventilated, should be raised off the ground and provided with taps. In addition to this they require to be periodically cleaned out and flushed with boiling water to which permanganate of potash (16 grains to gallon) has been added, or roughly, 1 teaspoonful to 3 gallons of water. If, after rinsing, the mixture comes out discoloured, it shows cleaning was necessary, and the process should be repeated till the mixture comes out with the pink colour not destroyed. Dirty water receptacles are very dangerous. Posts on the "lines of communication" should manage to have enough "sterilised" water on hand to supply the wants of detachments passing through by rail, road or water.

Purification of Water.—No water on service should be used for drinking or cooking purposes that has not first been rendered safe (sterilised) by either (1) *Distillation*, (2) *Boiling*, (3) *Filtration*, or by (4) *Chemical Means.* (M.F. Eng., S. 63.)

1. **Distillation.**—This process, in which the water is first boiled and the steam condensed, if properly carried out, renders the water absolutely safe to drink, but is very expensive, and rarely used now except on board ship, as in the navies of the world, where it gives excellent results. The American, French and Japanese troops, at present stationed at Peking, in North China, distil all water for drinking purposes, and consider this method to be the safest and the best.

(2) **Boiling.**—When this can be properly carried out, it is usually the simplest and best method. As a rule, it can only be done on a large scale at posts on the "lines of communication," and water-boiling stations were established at these places by both armies in the recent war in Manchuria, where hot food was also provided. With troops on the move, the question of transport for boiling water plant has always presented great difficulties. Water can, of course, be boiled in mess-tins, camp-kettles, etc., but this is generally unsatisfactory. The Japanese soldier boils water in his water-

bottle, which is made of metal and has no cover, he afterwards drinks the boiled water, or makes it into tea. Larger quantities during the war were boiled in iron rice cauldrons, Chinese boilers, etc. If the water after being boiled was muddy, alum was used to clarify it, a supply of this being carried by the head-quarters of every unit. In the Russian Army it was much the same. If tea drinking was more universal in our Army the water difficulty would be much simplified. Selous, the famous African traveller and hunter, has said that he personally always carried a "billy," and when he wanted a drink he made tea. The water-bottle, which has a capacity for about 1½ pints of water (weighing 2 lb.), should be filled with boiling water or tea overnight, corked and hung up outside to cool, when it will be ready in the morning. Water should never be kept in water-bottles when not in use (see Para. 1717 K.R., also Ch. IV., *Prevention of Enteric*, and Ch. VI., *Sanitation on the Line of March*). It is no use to put boiled or otherwise sterilised water into dirty water-bottles. The difficulty, especially in the Tropics, when water has been boiled in large quantities, is to get it cool enough to drink and prevent it from becoming contaminated in this process; which should never be entrusted to natives. Boiling water for five minutes removes the "temporary" hardness,

and is sufficient to kill all disease-producing germs. On the other hand, boiling water does not remove mud and other suspended matters, or poisons in solution. These latter may be derived from decomposing animal bodies, or may be of mineral origin, and introduced from the soil, by accident, or by the enemy.

Poisons derived from decomposing animal matter produce *Ptomaine poisoning*, which is, however, more often conveyed by eating bad food than by drinking bad water (see Ch. VII., *Food*). Before boiling, the water should be strained to clear it of mud and sediment.

Heat Exchange Apparatus.—To overcome the difficulty of cooling water after it has been boiled, several forms of apparatus on the heat exchange principle have been invented. The one used in the Army is called the "*Griffith*" *Steriliser*. The incoming cold water extracts heat from the outgoing heated water, raising its own temperature, and *vice versa*. It has been found that a temperature *less* than that of boiling water, namely 180° F., is sufficient to destroy all disease-producing germs in water—such as those of Cholera and Enteric Fever—so actual boiling is not necessary. The apparatus is made in two parts for transport, a "Heater" and a "Cooler," and kerosene oil is used as fuel. The outcoming water is sufficiently cool to drink. This kind of steriliser

is not suited for mobile troops and rough transport, the larger form being somewhat heavy and complicated, but might be used at posts on the "lines of communication," where, however, ordinary boiling could no doubt be carried out as before mentioned.

Boiling water for drinking purposes is the almost universal practice in South Africa and many other foreign stations.

(3) **Filtration.**—Rough filtration of water has already been described under *Methods of Straining*. Different patterns of filters (charcoal, sponge, etc.) have been used in the Army for many years past, but frequently they did more harm than good by giving a false feeling of security in drinking water so treated, as the filtering material used often became so filthy that it added impurities to the water instead of removing them. If filters are used at all, only those which will remove *micro-organisms* from the water are recommended.* These are made either of compressed infusorial earth (minute marine shells), or unglazed porcelain, the former being represented by the *Berkefeld*, and the latter by the

* At present there appears to be a party in favour of compromise in regard to water sterilization in the field, *e.g.*—they recommend straining or clarifying instead of *germ* filtration. This would appear to be a dangerous retrograde movement as long as the present germ theory of disease is accepted. (See page 19.)

Pasteur-Chamberland filter. These filters are made in the form of hollow cylinders, called candles, or *bougies,* enclosed in metal cases, and are generally familiar. Filters of this kind have been in use for about ten years, but from a military point of view have many disadvantages, the chief of which is that the candles and fittings are easily damaged by rough transport, and when cracked the filters are quite useless. To clean and look after them generally they require trained men. They easily become clogged when the water is muddy, unless it has been strained first, and about every fourth day the filters themselves require to be boiled and brushed, which means much handling and consequent danger of accidents. The *Slack and Brownlow* is the pattern of filter in general use.

Filter Water-carts.—Where Filter Water-carts are provided, all water for drinking and cooking purposes should be drawn from them—stand pipes not being available—and they must be kept constantly filled so as to be available for use by the whole unit, and not appropriated to any one mess or cook-house. The present pattern of service water-cart has endeavoured to meet some of the objections to candle filters in the manner of its construction, the candles, which are eight in number, are arranged in two sets of four each, and placed inside the cart to protect

them as much as possible from damage. In addition to the eight candle filters, each cart is fitted with two " strainers," made of compressed sponge, through which the water passes before reaching the candles; in addition, each filter tube is covered with cloth to lessen clogging. The apparatus is worked by two hand pumps, one on each side. At the back of the cart there is a 7-gallon tank to receive the filtered water, and, connected with this 12 taps are fitted round the sides for filling water-bottles. The main tank (capacity 114 gallons), with the other fixtures and spare parts, is mounted on two wheels and drawn by two horses. The A.S.C. driver rides the near horse, as there is no seat. The water-cart takes twenty minutes to half an hour to fill with average supply of water, and if the apparatus is in perfect working order, will turn out sterilised water at the rate of about 200 gallons per hour. These carts do not add to Army transport, since they simply replace the ordinary water-tank carts, three being allotted to each Brigade of Artillery, two to each battalion of infantry, and one to each regiment of cavalry. Their place on the march is generally 2nd Line Transport (see F.S. Reg., Part I., S. 28). So far these carts have only been used at manœuvres and on fairly good roads. To be satisfactory they must be entirely in charge of the trained personnel provided by the R.A.M.C.

For the duties of this personnel see Ch. VII., *Field Service Sanitary Organisation.* These carts should always be driven by experienced drivers and horsed with selected and steady animals, as they are difficult to manage. Civilians should never be allowed to drive them. On manœuvres, when out of sight of camp, they are sometimes to be seen driven at a gallop, and instances have occurred where they have been upset on the road, and the filtering apparatus ruined. If this occurs on peace manœuvres, what is likely to happen on active service. When filled with water, the present pattern cart is extremely heavy (about 20 cwt.), and badly balanced, the driver has comparatively little control over the horses, and the frequent application of the brake, on going downhill, is calculated to damage less delicate things than "candle" filters. A more portable variety of this double filter, capable of being carried on a pack-saddle, is made and will filter 60 gallons an hour.

(4) **Chemical Means.**—Chemicals are sometimes used for purifying water, and have been recommended for military use, but as they generally impart an unpleasant taste to the water if used in sufficient quantity to kill germs, and as their success depends on the individual action of the men, they are generally regarded as unsatisfactory. The use of alum

and permanganate of potash has already been referred to.

Method Employed at Ladysmith.—During the siege of Ladysmith the water supply of the troops was carefully guarded in the following way: Mud was first removed by the addition of alum (6 grains to the gallon) and straining through several folds of linen or khaki cloth, afterwards the water thus cleared of mud was passed through a *Berkefeld* filter without blocking the candles, and finally, if possible, was boiled, and so rendered safe for drinking.

It may be said that some form of "candle" filtration has been adopted by most modern Armies for use when boiling is not practicable. On field service fuel is frequently only sufficient for cooking purposes, lighting fires gives away the position and has an unpleasant way of drawing the enemy's attention.

Japanese Canvas Filter.—The Japanese, who have not adopted the *Berkefeld* or other "candle" filter for military use, in Manchuria, towards the close of the war with Russia, used a conical bag, about two feet long, made of waterproof canvas with two side sleeves, and known as *Ishiji's Filter*.

Filtration was effected by the water in the bag passing through charcoal and sponges in the sleeves, from which it was drawn off, a precipitating powder, the composition of which

has been kept secret, having first been added, and time allowed for the mud to settle. A metal ring, with joints for folding, is let into the rim by which the filter can be suspended when in use. It is claimed for this canvas filter that it is simple, handy, effective, cheap, and does not get out of order with rough use, which are the essentials for any apparatus designed for use on field service.

See M.F. Eng., Table 13.

CHAPTER VI

SANITATION IN BARRACKS, IN CAMP, AND ON THE LINE OF MARCH

Ventilation.—Proper ventilation in barracks is of the first importance. The windows of every barrack-room will be opened sufficiently to allow of free ventilation, and will be kept open as far as the weather and season admit (see Para. 1003 K.R.). This is specially necessary at night when the rooms are occupied, and the upper sashes should be open at least three inches at night all the year round, in addition to being thrown wide open in the morning before the men turn out. They should be left open as much as possible during the day. No overcrowding should be allowed, the number of men allotted to each room being usually shown on the door, and also on A.F.K. 1251. Bed cots should be separated as far as possible from each other and drawn out from the wall from six to twelve inches, to allow the air to circulate around each occupant, which is, perhaps, the most important requirement in barrack hygiene.

Composition of the Air.—Pure air is a mixture

of 21 parts of oxygen with 79 parts of nitrogen, containing also water vapour, a trace of ammonia and 4 parts of carbonic acid gas in 10,000 parts of air. This air is rendered impure by being breathed, or by gas, oil or candles being burned in it. When fresh air is taken into the lungs and then breathed out again it only loses about 5 per cent. of its oxygen, but the quantity of carbonic acid gas added to it is increased from 4 to 470 parts in 10,000. The quantity of carbonic acid gas present in the air of a room is therefore taken as an index of impurity. Air which has been breathed is also heated, saturated with moisture, and contains much organic impurity, which is increased by the exhalations from the skin, soiled clothing, bedding, etc. It is this organic impurity which gives the "stuffy" smell to a badly ventilated room.

Formerly, badly built barracks, which were usually overcrowded, produced much disease in the Army, notably Consumption, but in the last 50 years both the cubic and the floor space allowed to each occupant has been very much increased. Tonsillitis and barrack-room sore throats are still far from uncommon, especially in winter, and although commonly attributed to cold, bad smells, etc., are more often caused by dust, and the want of proper ventilation in barrack-rooms. All infectious diseases are also easily spread among troops in the same way.

Cubic and Floor Space Required.—At Home Stations the accommodation is arranged to give each bed in a barrack-room or wooden hut 600 cubic feet of air space, and 60 square feet of floor space. The floor space is the important element in cubic space.

Barrack-rooms are generally 62 by 20 feet in area and 12 feet in height, allowing 600 cubic feet per head for 24 men. *The modern provision of dining-rooms should not be allowed to reduce the above minimum allowance.* Each man requires about 3,000 cubic feet of fresh air per hour, so that the air in a barrack-room, in order to keep it free from any unpleasant smell, ought to be changed about five times in the hour.

Natural ventilation takes place by windows, doors, fire-places, and by special ventilators, both inlets and outlets, fixed in the walls. When a fire is burning the fire-place is the best outlet for used-up air. As far as possible ventilation should be carried out without causing a draught. In windy and inclement weather the windows on the lee side can usually be opened without discomfort and, as breathed air being heated rises towards the ceiling of a room, the top of the window is the best part to open. The best test of good ventilation is to perceive no unpleasant smell on entering an occupied barrack-room from the outside air, especially at night and in the winter, when windows are more likely

to be shut. Windows are by far the best ventilators, and should always be made with their tops reaching as close to the ceiling as possible. The tendency in recent years has been rather to provide too many other ventilators, which in cold weather are often found blocked with paper, old clothes, etc., to prevent draughts.

Defects in Existing Barracks.—In recent years the general standard of comfort has been much improved, but much still remains to be done in order to render the average barrack-room an ideal home for an educated and sensitive man. It must be remembered that the type of recruit has changed very much in the last 50 years.

Apart from the buildings themselves, which are in many cases old and dilapidated, the chief defects at present are the arrangements for lighting and heating. In many barracks oil is still the only illuminant, while gas, ordinary or incandescent, is less common, and electric light has only been installed in a very few instances. The new barracks at Tidworth, for example, are lighted by oil. This is anomalous when the provision of electric lighting, where gas is not available, is considered a modern necessity in all civil buildings and institutions. From a sanitary point of view, electric lighting is much to be preferred, as it is cleaner, gives a better light, burns no air ; it also requires little

or no attention, does not leak, and is less likely to cause fire, to the precautions against which sixteen paragraphs are devoted in K.R. If adopted generally, its cost should be little more than gas.

The heating of barracks, usually by fire-places or stoves, is far from satisfactory, and the introduction of a more modern type of fire grate (in place of the sealed pattern Galton), or better, some form of "central heating," would be a great advance in cleanliness and comfort during the winter months, if not an actual economy in the expenditure of fuel. We still occupy many barracks which are quite obsolete if not actually condemned, some of them built in the early part of the 18th century. The absence in many cases in our barracks of modern conveniences, in construction, drainage, water supply, bathing accommodation, heating and lighting, etc., is remarkable, considering the revenue of England, and the fact that her standing Army is only seventh on the list of the Great Powers in numerical strength.

The Half Battalion Combined Barrack.—This type of barrack may be taken to represent the most modern arrangement in the Service. It consists of two double-storied blocks, each holding two companies, facing inwards, with the dining-halls and single cook-house between. It is provided with covered ways and verandahs.

Each room, which measures 36 feet by 23 feet 6 inches by 10 feet 6 inches, accommodates 12 men, and has three windows and a fire-place. The ablution rooms are on the outside. The cook-house is arranged for the double service, and bath-rooms and drying-rooms for kit are near it. There are separate rooms for N.C.O.'s and company stores. It is stated that the extra cost of building these barracks is little more than that for the older pattern. It is an axiom that barrack-rooms and married quarters for mounted units should never be placed over stables, but in some stations these still exist.

Sanitation of Barrack-rooms.—The cleanliness of the sleeping-room is a matter of the greatest importance to the health of the occupants. This includes the floors, walls, ceilings, windows, kit-shelves, boxes, bed cots, bedding, kit and everything that should be kept in the barrack-room. Food should never be kept and, as far as practicable, never eaten in the barrack-room, and the common practice in mounted units of allowing harness, etc., to be cleaned and kept there is to be condemned, as it occupies valuable cubic space, if for no other reason. The habit of keeping dogs and cats in barrack-rooms is not to be recommended, as they carry vermin, and probably also disease. The floors of barrack-rooms are made dirty by the constant traffic

in and out with boots, especially in wet weather. The provision of boot-scrapers and door-mats would help to prevent some of this. The usual sweeping out simply transfers the dust from the floor to the men's bedding and kit.

Floors are generally dry scrubbed (as it is termed) daily, and wet scrubbed, or washed with soap and hot water, once a week. This washing of the floor should, as a rule, only be done in dry weather, and the first thing in the morning, in order to allow the room to dry before evening ; opening the windows on both sides will facilitate this drying. As little water as possible should be used, as it sinks through the cracks, and rots the flooring. The almost universal habit in the British Army of throwing water about broadcast, and regarding it as evidence of cleanliness is difficult to check, but, like indiscriminate whitewashing of the outside of barracks, it should give place to better methods. Brushes, mops, damp cloths, pails, etc., used for this washing should not be kept in the barrack-room, as they cause a musty smell, but outside in the special place provided for them. These articles should be reserved for use in the barrack-room only, and should not be borrowed for other purposes. It is sometimes recommended that hot sand should be sprinkled on the floor to assist drying, but fresh sawdust is better, is not irritating to the lungs

when afterwards removed by sweeping, and can be burnt. All parts of the floor, especially that between the bed cots and wall and under the bed cots, should be washed, and not only the middle of the room, as is sometimes noticed. Bed cots, in addition to ordinary washing, require periodical cleaning with kerosene oil, say once in six months, which removes dirt, and is fatal to vermin. Blankets should never be used as mats except when kept for this purpose only, but clean newspapers answer the purpose well, and may afterwards be burnt.

Bedding.—Each soldier in barracks is supplied with one coir mattress in three pieces, three brown "general service" blankets, which do not show dirt (one extra in winter), one thin time-expired under blanket with the corners cut off, two sheets, one coir bolster and one pillow slip. Bedding is not the property of the soldier, but is held on barrack charge, and is exchanged on the indent of the Commanding Officer at Home Stations after it has been in use for the following periods:—Blankets, 12 months; sheets, 2 weeks. The three pieces of the coir mattress are covered with tan coloured cases, each piece weighing 9 lbs. The coir bolster contains 2 lbs. of coir fibre. The mattress and bolster are remade, if necessary, every 12 months, either by the troops, by contract, or in Detention or Branch Detention Barracks.

Bedding and kits should be frequently brushed, shaken out, and hung up outside in fine weather (lines and posts being provided between barrack blocks), as nothing cleans like fresh air and sunlight. Infectious diseases, such as Enteric Fever, as was proved in South Africa, are often communicated by dirty blankets; and skin diseases, such as itch, are commonly spread in this way. Blankets are only changed once a year, and presumably washed at the same time. These useful articles are exposed to all sorts of contamination in the barrack-room, and in camp, and are constantly mixed up on being returned to store when a man goes on furlough, into hospital, on manœuvres, to Detention Barracks, etc. In this way a naturally clean man is often served out with blankets which have been used for months previously by a dirty man. It has been suggested that each man's blankets should be marked with a distinctive tally bearing his number and name, and this has been adopted at Pretoria and other stations in South Africa. The whole question of issue, changing, mending, remaking and washing of bedding seems to call for more consideration. If sufficient apparatus was provided, the barrack bedding of each unit could be *sterilised* by steam heat once in six months by the troops themselves, which would be much more useful than indifferent

washing done by contract. In India recently steps have been taken to ensure the more frequent and more thorough washing of soldiers' bedding. It is now ordered to be washed, under regimental arrangements *at least* once a quarter.

Arrangements have also been made for the washing of all blankets *before being returned into store,* and for their disinfection in all stations where steam disinfectors are provided.

For further information see "Supply Transport and Barrack Services, 1909."

Dining-rooms and Cook-houses.—A separate room should, if possible, always be set apart for meals, thus keeping food out of the barrack-rooms. Tables should be kept clean and white by daily scrubbing with hot water and soft soap. If American cloth covers are used, these should not be fixed to the tables, but simply laid on them, so that they, as well as the tables, may be kept thoroughly clean. Sawdust laid on the floor helps to keep it clean; it should be fresh and renewed daily. All dishes, plates, mugs and other utensils used for meals and for the storage of food should be kept perfectly clean, and all cleaning done in the wash-up rooms or on the scullery table, not on the floor or at the taps outside. Clean cloths should be provided daily, and bath-brick for scouring tea cans, milk tins, meat dishes, etc. Attention

should be specially given to tables (including the under side and legs), drying racks for dishes (which should always be removable), chopping-blocks, and to knives, forks, etc., used by cooks, which require daily cleaning after use. Tables should be scrubbed at the special place made of cement-concrete, provided in most modern barracks, where the dirty water can at once drain away.

The danger of *ptomaine* poisoning from dirty cooking utensils, due to decomposed animal matter, should be kept in mind, and these articles frequently inspected. An order-board, with a few simple directions placed in all cook-houses and signed by the Adjutant, will help very much in the carrying out of these essentials. The washing of hands before meals by all ranks, especially in mounted units after "stables," should be encouraged, and time allowed for this; and the wearing of white overclothing and caps by cooks, as in civil life, is to be recommended.

The Restaurant System.—This method of serving meals, where separate dining-rooms are provided, is growing in popularity, and the following advantages are claimed for this system:—

(1) That it affords a greater variety in food, combined with economy.

(2) That the meals are served hot, and in a neater and cleaner manner.

(3) That the barrack-rooms used for sleeping are kept cleaner, and their ventilation can be more easily carried out when not used for meals.

On the other hand, the restaurant system is *in no sense a preparation for the needs of war*. The inspection by regimental officers of the quality and quantity of all kinds of food supplies coming into barracks for messes, coffee-shops, institutes, such as meat, bread, milk, groceries, beer, minerals, etc., and the cleanliness of all places where food or drink is either prepared, consumed or stored claims attention (see Paras. 103, 903 and 1038 K.R.). Only authorised hawkers provided with a pass should be allowed inside barracks (see Para. 1039 K.R.).

Baths and Bathing.—Bathing and lavatory accommodation in many barracks still requires improvement. In the older buildings this is often situated in the basements, and is damp, cold and cheerless. In some barracks the old slate baths still remain in use, in the majority immersion or plunge baths are provided, while some of the latest buildings have shower-baths. The supply of hot water for bathing and washing is now looked upon as a sanitary necessity, and hot water installations are being

extended as far as funds permit. A great deal of money is spent annually on "tinkering up" old buildings, when what is really wanted are entirely new buildings.

Every man should have a hot bath at least once a week, and recruits require special supervision. In some units a bath-book is kept, and in it the names of all men having baths are supposed to be entered by the bath-man. The utility of this is open to question. The hours when baths are available on week-days and Sundays should be entered on a notice-board, and during these hours the N.C.O. or man in charge should be present and responsible that the water is hot and not merely lukewarm, or cold, as is often the complaint. Every man should be made to leave the bath-room as clean as he found it. The scale of fixed baths in barracks is one per cent. of strength, and one bath in each block for sergeants.

Foot-baths have been fitted in some barracks, and their use should become general, especially for infantry, but in addition to, and not as a substitute for ordinary baths. *Shower-baths* are very suitable for soldiers, especially in hot climates, but, in order to prevent a chill, the water should be warm. Englishmen have got a great reputation for "tubbing," but this habit does not usually extend to the soldier in the ranks, who often has a rooted objection to

water in this form. More comfortable and better appointed bath-rooms, supplied by a separate hot water system not dependent on the cook-house, would do much to overcome this prejudice on the part of many men to bathing. Personal hygiene, which begins with the bathing of the body, is the foundation of all Army hygiene (see Ch. VII.), each man must be taught to keep himself clean, and the other things will follow as surely as night follows day.

Captain B. Vincent, R.F.A., one of our Military Attachés with the Japanese Army, reports on the 17th May, 1905: "The Japanese soldiers always contrive to have a hot bath, and on this subject no orders are necessary. Through long custom among even the poorest classes in Japan, a daily bath in water at very nearly boiling point is considered almost as great a necessity as food. On service the soldiers generally manage to bathe every other day, and even in the coldest weather a naked soldier standing in the open, drying himself by the bath, is a common sight. All through the winter this bathing was kept up. The large earthen jars, about 4 feet by 2 feet, which are to be found near every Chinese house, are requisitioned for the purpose, a charcoal or wood fire being lighted underneath." To say that the temperature of the bath water is "at very nearly

boiling point" (212° F.) is rather an exaggeration, as a Japanese hot bath practically never exceeds 120° F. In Japan soap is not used *in* the bath, the soaping and washing being done before entering the bath, and so hot water is economised, and the same water may be safely used by a number of persons. On the Japanese transports in 1904 each man is said to have had a hot bath daily. Compare this with one of H.M. transports, making the six weeks' voyage from Hong Kong to Southampton as recently as 1907 with over 1000 troops on board, where the bathing accommodation provided by the Admiralty for the men consisted of one cold sea water spray bath. The sail bath on deck is only possible during the hot part of the voyage. Facts like these teach that we have much to learn from the Far East, even in matters of personal cleanliness.

Latrines and Urinals.—These are provided in barracks on a certain scale to the strength, the former (seats) at 6 per cent., with one in each block for sergeants, and the latter at 4 per cent., with one in each block for sergeants. Latrines and urinals are in the charge of troops in occupation of barracks, who are responsible that they are kept clean and in working order (see Paras. 1006 and 1007 K.R.). Where the new type of pedestal closets with flush tanks are fitted, the men should be encouraged to use them

properly, and not to break the seats and chains as they often do. Where civilians are not employed, certain sanitary men of the unit should be permanently detailed for this branch, and not constantly changed or taken away for other duties. They should be always present at inspections with the Corporal-in-Charge. Nothing but toilet paper should be provided and allowed to be used, attention to this will save many requisitions to the R.E. on account of blocked drains. Neither the flush-tanks nor the seats can yet be considered quite satisfactory.

One of the chief sanitary essentials is to keep latrines and urinals free from flies and smell, and if well looked after this should be possible even in the hottest weather. This is helped by the free use of a solution of Cresol (1½ ozs. to 1 gallon of water), 2½ per cent. of crude carbolic acid in water, Jeyes' fluid, etc., muriatic acid, or spirits of salts, should be used about once in three months to clear the traps and pipes. Daily flushing of pipes, scrubbing of seats (both sides) and, in the case of urinals, painting with "heavy oil" is necessary. These necessary adjuncts to all barracks, placed as they are at the very doors of the barrack-room, require constant supervision to ensure that they are not allowed to become insanitary.

Night Urinals and Night Tubs used in

barracks also require attention to prevent them causing a nuisance. The provision of night tubs is condemned on sanitary grounds as likely to lead to pollution of passages, etc., either during use, or afterwards when being removed, and night-urinals with automatic water-flush (locked during the day) connected with the drainage system are now being substituted for them. To some officers this part of the subject may appear more suited to the pioneer sergeant or sanitary corporal than to them. This is a great mistake and, unfortunately for the Army, only a too common one. All officers should understand something about these matters. The close connection already shown to exist between latrines, flies and disease shows that personal supervision given by squadron, battery and company officers to this part of their lines, whether in barracks, in camp, or on the line of march, is attended with the best results, and without any sacrifice of dignity. The cleanest regiments in barracks are without exception the smartest on parade, and the best in the field, and this cleanliness to be real must include everything in the regimental lines. The G.O.C. 13th Infantry Brigade, in Ireland, a few years ago, said: "I can unhesitatingly state that the very best results have been produced. Perfection has in no way been reached, but the

general improvement in barracks and camps has been most marked. The men are young, and bring with them from their homes the crudest knowledge of sanitation; the non-commissioned officers are equally ignorant of the importance of this subject." He is here speaking of the sanitary training of his brigade, which extended over six months, and included three distinct stages, namely—(a) in barracks; (b) during field training; and (c) at manœuvres.

The experience of war has only emphasised the importance of this part of sanitary science, which must be learnt during peace, and, as both N.C.O.'s and men are as a rule ignorant of its importance and notoriously "absent-minded," the co-operation of regimental officers is urgently required.

Water Supply in Barracks.—This is under the R.E. as regards source and fixtures, the R.A.M.C. as regards quality, and the A.S.C. as regards quantity. For the scale of water allowed in barracks see Para. 1037 K.R. Certain fatigue duties are carried out periodically by troops in occupation of barracks in connection with water and drainage, either themselves, or under the supervision of the R.E., such as cleaning cisterns, grease-traps, gullies, inspecting automatic flush tanks (for drains), testing stop cocks, etc. Particulars will be found in the "*Regulations for Engineer*

Services—Drainage Section," and in "*Instructions in the Care of Barracks,*" which is issued to units for guidance in the more technical part of the duties, and should be in the hands of all Q.Mr.-Sergeants, Pioneers and others performing sanitary duties in military commands, price 9d. (See also Paras. 1004, 1005, 1007 K.R.), and Ch. V., *Water Supplies.*)

Disposal of Refuse in Barracks.—All refuse, from whatever source, should be removed daily by the contractors, or burnt. All receptacles should be made of metal, not of wood, which is absorbent, raised above the ground on concrete platforms, and provided with well fitting lids with handles. Separate bins should be provided for kitchen and dining-room waste, and ash-bins kept for ashes only. Special attention requires to be directed to the contract for the removal of stable litter, which is often very imperfectly carried out, the neighbourhood of the stables swarming with flies in consequence. One of the sanitary men should see that the contractor's men do not spill the contents of refuse-bins or tubs on the ground around, as they are so fond of doing, and by going round with the cart this can be prevented. Paper and all dry rubbish which is not specially contracted for should be daily burnt in an incinerator built by the R.E. in the lines of every unit, and put in charge of one of the sanitary

detachment. The regular daily use of a destructor in barracks is to be strongly recommended, if only for practice in the habit of this method of disposal of rubbish (see also *Disposal of Refuse in Camp*). The ground surface in barracks requires to be kept perfectly clean and level at all times by brushing, picking up paper and rubbish, filling in depressions in the ground with gravel, shingle, ashes and cinders, broken stones, etc., and afterwards rolling. Tarring of roads and paths recently introduced in the same way as done by municipalities is excellent, the ground surface so treated is non-absorbent, easily kept clean and economical in labour.

Sanitary Inspections of Barracks.—These are made once a month by the officer in medical charge of troops, the result being entered in the "Sanitary Diary" (Army Book 39). Any defects in sanitation or cleanliness, or otherwise, are noted, etc., and the Diary is then passed to the O.C., the unit concerned (a separate book being kept for each unit), who, after recording in it the *action taken* (not simply "noted"), returns it to the M.O. These books are forwarded monthly to the Administrative Medical Officer (A.M.O.) of the District for his perusal. Other sanitary inspections are made by the Principal Medical Officer (P.M.O.) of the Command, the A.M.O., and by the Inspector

of Medical Services. (See Paras. 26, 986, 987 and 1088 K.R.).

At these monthly inspections the M.O. is generally accompanied by the Quartermaster of the unit or his representative. It would greatly facilitate matters if, when a senior officer of the regiment is not able to be present, the "orderly officer" for the day was to accompany the M.O. in his tour of the barracks, etc. This suggestion has been adopted in some units, and is a great improvement in every respect.

Sanitation in Camp, Billets and Bivouacs.—Sanitation in camps, etc., is regulated by the same rules as apply generally to barracks, with modifications to suit local conditions. Every officer is responsible that all orders affecting the health of the Army are rigidly carried out by the troops under his command. Neglect of sanitary precautions inevitably results in great loss of life and efficiency. The subject of water supplies is considered in Ch. V.

Sites for Camps and Bivouacs.—(See F.S. Regs., Pt. I., S.S. 50 to 63). These should be dry and on grass, if possible, steep slopes must be avoided, but gentle slopes facilitate drainage. Large woods with undergrowth, low meadows, the bottoms of narrow valleys and newly turned up soil are apt to be unhealthy. Clay is usually damp and cold. Ravines and water-

courses are dangerous sites, as a sudden fall of rain may convert them into large streams. Sites of old camping-grounds should, if possible, be avoided. Other points to be considered are the facilities which the site offers for obtaining shelter, fuel, forage, straw, and supplies generally. In the presence of the enemy tactical considerations come first. *Camps* as a rule are healthier than bivouacs and admit of concentration, but will only be used on service under exceptional conditions, being replaced by huts if the force is likely to remain halted for some time, as for instance in a siege or blockade. In the Tropics, huts should be raised off the ground level. *Bivouacs* give the maximum of concentration and readiness, but as a rule are trying to the health of the men, and should only be resorted to when absolutely necessary from a tactical point of view. *Billets* are the usual form of quarters in civilised countries when not in immediate proximity to the enemy. They allow of proper rest, and give shelter from the weather, but usually cause dispersion of the troops. It should be remembered that a bad billet is usually preferable to the best bivouac. The dispersion of troops may be partially overcome by resorting to *close billets*, when as many men as possible sleep in houses, the remainder bivouacking. (See M.F. Eng., S. 64.)

On the line of march the utmost possible use

should be made of buildings on or near the roads by which the force is marching, and wherever possible they will be allotted in advance (for data as to accommodation in billets, see F.S. Pocket Book, p. 34).

In allotting billets regard will be had both to the comfort of the men and the interests of the inhabitants, but in close billets, considerations of comfort will have to give place to tactical considerations.

Sanitation in Billets.—This is usually carried out by the local authorities, assisted by the troops and additional latrines, watering and washing places will often be necessary. Billeting parties will ascertain the source of the local water supply and what measures are necessary to protect it, also the sanitary system of the place. They should make enquiries as to the existence of infectious disease. If this exists, sentries should be posted over infected houses, or other houses in which it is not desirable to quarter men. All billets should be left scrupulously clean, especially if they are to be occupied again by the same or other bodies of troops.

Intervals in Camp.—The usual intervals in camp are:

1 yard between the pegs of each tent,
10 yards between units,
1 yard between squadrons,
3 yards between companies.

As a general rule, the shape and size of a camp or bivouac will be determined by the ground, care being taken that units are not cramped more than is absolutely necessary. For details as to tents, sizes of camping-grounds, etc., see F.S. Pocket Book, Ch. II. (7).

Surface Drainage.—A trench should be dug immediately under the curtain of a tent, and the excavated earth banked on the outer edge of the trench. The curtains should then be pegged to the inner slope of the trench, the canvas thus draining into it. Surface drains should be constructed to prevent rain-water lodging in the trenches. Half-an-hour's work on the first wet day, when the natural run of the water can be seen, will do more to keep the camp dry and healthy than a day's work in dry weather. Tent flies are to be looped up the first thing every morning, in wet weather on the leeward side only.

In a standing camp tents will be struck periodically, and the ground underneath well swept and left exposed for some hours at least, the tents being afterwards replaced on their former sites and never in the intervals on account of the possibility of the ground being polluted by urine. For sanitary reasons dry and sunny weather should be chosen for striking tents and, if tent-boards are used, they will require to be taken out at least once a week, scrubbed with

soap and water and allowed to dry before being replaced, as they soon become very dirty. Tents are usually pitched with the doors facing away from the prevailing wind, in mounted units they face the horse lines. On account of the danger of fire, lights are never to be left burning in unoccupied tents.

If rain is expected tent ropes are to be slackened, and a hole may be dug (about 6 inches deep) near the tent pole to put this into in case of a storm suddenly coming on at night. This precaution will often save the tent coming down. If the camp is pitched in or near long dry grass or heather, special precautions must be taken against fire.

Sometimes it is advisable to beat the tent floor well down and sprinkle it freely with Cresol solution, to keep away flies and creeping insects, such as harvest-bugs, spiders, centipedes, etc. No fouling of the ground surface in any part within the camp perimeter should be permitted, as it is only by attention to this that disease can be prevented.

Latrines in Camp.—Separate latrines are necessary for officers, N.C.O.'s and men, and also for natives when employed. In standing camps they should be made to seat 5 per cent of the troops, if possible, and a rail system of removal should be established. The position of latrines, urinals, refuse pits, etc. should be

indicated by notice-boards. Latrines should be dug as soon as possible after the troops reach their camp or bivouac. The trenches should be arranged in one line, with 2½ feet clear space between each trench. The size of each trench should be 3 feet long, 1 foot broad, and 1 foot deep. After use on the second day these trenches are filled in, and fresh ones dug in the intervals. On the third day a fresh row similar to the first is commenced 1 foot to the front, and parallel to it.

If the ground available is limited in extent, the trenches may be increased to 2 feet in depth, and made to last over the second day. In excavating the trenches, the turf covering each should be removed and placed about 3 feet behind each trench, the sides should be kept vertical, and the excavated earth should be well broken up and piled up between the trench and the turf.

As a rule 5 trenches should be provided for 100 men for one day, but 15 trenches (*i.e.*, 3 per cent.) will suffice for a strength of 500 men. If material is available, the trenches should be surrounded by a screen with an overlapping entrance formed in the centre of one of the sides. The length of screen necessary to surround latrines for 1000 men, calculated on a 5 per cent. basis, is about 130 yards. It is very important that a couple of inches of the driest earth obtain-

able should be thrown each day into latrine trenches in use. If means are available, the earth may be artificially dried for this purpose. If carefully carried out this will obviate all smell, and will tend to prevent flies collecting. The use of kerosene oil, lime, carbolic acid mixed with sawdust, Cresol solution, etc., in and around the trenches will still further assist in keeping flies away.

Small shovels or improvised scoops should be provided, when possible, in the proportion of one for every two short trenches. Small empty tins do very well. Latrine trenches should be filled in at the last possible moment on vacating a camp or bivouac, a certain number of the regimental sanitary detachment being left behind, if necessary, to do this, and the position marked with the letter L formed of stones, etc. (see Manual of Field Engineering, 1911, S. 67, and Plate 38, Fig. 1).

These shallow trenches are much more easily made than the deep trenches formerly used, and are in every way more sanitary. They are used in the straddle position, which prevents fouling, and so seats are unnecessary.

Ground Necessary for Latrines.—To obtain the *frontage* of ground necessary for latrine trenches (calculating on the basis of 5 per cent.), multiply the *hundreds* of men in camp by 6; this will give the frontage required in yards,

but only holds good when trenches are dug with $2\frac{1}{2}$ feet clear space between each.

To obtain the *depth* of ground from front to rear for trenches, take two-thirds of the number of days that the trenches are required for use, and this will give the amount of ground necessary in yards.

Example.—200 men require 10 trenches (at 5 per cent.) with a frontage of 12 yards ($2 \times 6 = 12$). If the camp is to be occupied for 30 days, a depth of ground of 20 yards will be necessary ($30 \times \frac{2}{3} = 20$). It has been proved that covering excreta with a limited amount of earth does not prevent flies breeding in latrine trenches. In India the use of earth in this way in barracks has given place to the use of pungent smelling disinfectants, such as Cresol, and the results are very satisfactory. This system might be extended to camps and earth only used for the final filling in. This method has been adopted in houses in Japan for years, Jeyes' fluid being generally used, and it absolutely prevents flies. The supervision of latrines is most necessary in order to ensure their proper construction in a suitable place, and that the contents are at once covered up with earth, or treated with disinfectants. Where bodies of troops are encamped or bivouacked close together, the general position of latrines, urinals and kitchens of each area will be settled by superior

authority, in consultation with the senior medical officer (S.M.O.); that is to say, it will be decided whether they are to be in front, at the rear, or on the flank of an area.

It has been shown recently in India that the excreta (fæces and urine) of a battalion 900 strong can be completely burned in two portable closed iron incinerators, by using the mixed litter available from the transport animals and line sweepings as fuel.

Disposal of Urine.—Urine may spread infection, and men are on no account to be allowed to urinate except in the latrine or urine trenches set apart for the purpose, or the special receptacles or trenches provided for night use only. A good form of urine trench is made as follows: Dig a soakage pit 4 feet square and 4 feet deep, and refill with coarse earth for 2 feet. From this pit make a trench, or arm, 1 foot deep, 2 feet wide, 12 feet long, and with a fall of one inch per foot towards the pit. New trenches are dug as required radiating from the pit, and the old ones filled in. Earth, lime, Cresol, or ashes from the kitchen fires and destructor, should be sprinkled in the trenches, or dry litter burnt in them daily. The pit should always be covered in, so as to compel the men to use the trenches or gutters. No oil should be used to smear the bottom of the trenches, as it interferes with percolation. As soon as a few filled-

in latrine trenches become available, the digging of special urine pits may be discontinued. The urine trenches, made as described, will then be led direct to the old latrine trenches, which absorb the urine rapidly. For halts of short duration, it will generally be found that it is sufficient to strip off the turf to the width of 1 foot, and such a length as may be necessary. This will clearly mark the spot to be used, and the fouling of the surface of the ground will be avoided. Spots thus prepared, in suitable positions near the lines, will probably be found preferable to tubs for night use. They should be lighted all night, returfed at dawn, and other spots stripped for use next evening.

Disposal of Refuse.—The rule is, burn all you can and bury what you cannot burn. All camp refuse should, as a rule, be collected and burned daily. Tins should afterwards be buried. For doing this *refuse destructors*, or *incinerators*, should be constructed of sods, earth, stones, etc., of a cylindrical or square shape inside, and banked up on the outside, with air inlets (2 to 4) left at the bottom. Measurements, 2 feet 6 inches wide inside, and 3 feet 6 inches high, the thickness of the walls about 12 inches. Two men can build one in two hours. Ashes and tins, etc., require to be periodically raked out. The sod destructor is as a rule the best, and as the material for it is generally available on the

spot, it is cheapest. The destructor should be built on the site from which the turf has been stripped, so as to minimise the risk of setting fire to the surrounding grass. The bottoms of the air inlets should slope outwards, to facilitate the removal of the ashes. A small fenced enclosure should be constructed close to the destructor for dumping refuse to prevent paper, etc., blowing about the camp. (See S. 68 and Plate 38, Fig. 2, M.F. Eng., and F.S. Pocket Book, p. 39.)

Disposal of Sullage Water.—Special precautions must be taken to prevent ground in the neighbourhood of kitchens and washing places being fouled by the greasy and soapy water. Efforts should be made to get rid of all the sullage water by means of soakage pits, the grease, etc., being first intercepted as far as possible by strainers of straw or other loose material. Soakage pits should not be made large and deep, and the circular form, which is most in favour, is the least suitable. It has been proved that three straight trenches, each 6 feet long, 1 foot wide and 2 feet deep, have a larger percolating area than a round pit 5 feet in diameter and 5 feet deep. From a hygienic point of view it is important to dispose of all foul water as near the surface as possible, the bacteria concerned in purification being most abundant and active in the surface soil, much less

labour is also necessary in making these shallow pits or trenches. In chalk or any other porous formation constituting the gathering ground for a water supply, deep soakage pits should be absolutely prohibited; in clay they are practically useless.

The following method can be easily improvised, and is specially suited for kitchens: Two large biscuit tins are taken, the upper one (which is perforated by holes in the bottom) acts as a coarse strainer and, when necessary, is emptied into a refuse tub; the lower tin has one hole above the bottom, made by cutting an inverted V-shaped piece, which is bent to form a spout. This spout empties into a small pit, 1 foot square, which acts as a grease trap and is filled with furze, dry grass, straw, etc., which is burnt and renewed daily. A narrow and shallow trench runs from the small pit into a soakage pit made somewhat larger (not more than 2 feet deep), or into straight trenches as above.

Ablution Places.—For ablution purposes in camp, V-shaped troughs with a narrow shelf on each side are usually provided. Water is laid on by a single tap at one end, or by a number of taps placed on each side of a central feeding pipe. The trough slopes to one end, and should be made to discharge over a wooden box, about 2 feet square, filled with straw, shavings, fine gravel, or coarse sand, to serve as

a rough filter, and then led away by a shallow trench into a soakage pit, or outside the camp, distributed over small areas of ground surface, which should be frequently changed, or on to cultivated land, etc.

The ground around stand-pipes, washing and bathing-places should be kept as dry as possible by laying down broken bricks, stones, ashes, etc., over which boards or brushwood can be placed, and draining away the water in the manner described for ablution places.

For Duties of the Regimental Sanitary Detachment, see Ch. VII., *Field Service Sanitary Organisation.*

Latrines, urinals, refuse pits, cattle lines, etc., must be situated at least 100 yards from, and if possible to leeward of, the water supply and the kitchens. They must never be placed in or near gullies, which, when it rains, discharge into the water supply, nor in any situation the drainage or filtration from which may possibly reach, and so pollute, the water supply.

Sanitation on the Line of March.—Rules for the line of march will be found in F.S. Regs., Part I., SS. 24 to 33 ; F.S. Pocket Book, Ch. II. (5) (6), and only a few points, which specially concern the health of the troops, will be mentioned here. No march of any distance should be started without first having a meal ; tea, coffee or cocoa, with bread or biscuits, is

easily prepared, more substantial fare being required if the march is to be a long one. Water-bottles (see Ch. V.) should be filled over-night with boiling water or tea, inspected by company officers before starting to see that they are filled, and used sparingly during the march. Men should not be allowed to "fall out" to get water, watering-places, if necessary, being arranged by the advance party, and boiled or filtered water provided. The filter water-carts, being usually second line transport, will not be available. The custom of drinking on the march at every opportunity is chiefly one of habit, and is a bad habit. Two kinds of thirst have been described, viz., 'the thirst of habit,' and 'the thirst of necessity.' In hot and dusty weather the column should be opened out on each side of the road and an increased distance allowed between sections of fours and an increased interval between men. The troops should be allowed to unfasten collars, unbutton jackets and slacken belts, to allow evaporation to take place from the heated skin, and so reduce body temperature and lessen fatigue. It is this body heat, retained by heavy clothing and equipment, which constitutes the chief danger to health in long and hot marches. It is the duty of every commander to spare the troops under him all fatigue that can be avoided.

Troops should not be kept standing on

parade waiting for orders, as this is most fatiguing and dangerous to health. A meal before starting and an *adequate* supply of suitable food and drink during the day are most important essentials and frequently forgotten. The history of many of our reverses in South Africa shows that the force, before commencing the attack, was frequently overmarched and so fatigued from want of sleep, food and water as to be quite unfit for fighting. In hot climates it has been found that distances can be covered with the greatest ease to the troops by marching as soon as it is light (not before) and continuing up to midday, with the usual short halts, and then halting for about three hours to enable the men to cook a meal and the animals to graze. The afternoon march should not be more than two to two and a half hours' duration, so as to allow of an hour's daylight in which to form a zariba (in bush fighting) and to distribute rations and water.

Night Marches.—These are, as a rule, destructive to health and efficiency, as they prevent proper sleep, and should be avoided as much as possible. It is of no use marching by night to avoid the heat of the day, and then to find that sleep is impossible on account of the sun and the absence of shade. It is of the greatest importance that troops should not be disturbed at night and their sleep broken to " strike camp "

until it is absolutely necessary, or by other bodies of troops being detailed to move out during the night, and no noise, such as hammering of tent pegs, chopping of wood, etc., should be allowed before the bugles sound *reveille*. Night-attacks should rarely be the sequel to a long night march.

Forced Marches.—These depend rather on the number of hours during which the troops are marching without long halts than on the pace, and, as a rule, if much indulged in, break the backbone of an Army and fill the hospitals with sick. It has been found that with selected troops and great attention to boots, feet, socks, clothing, equipment and load, with regular short halts for refreshments, and shampooing of the leg muscles, that long distances can be covered in an emergency.

Pace on Marches.—An Infantry Brigade should average about 3 miles per hour, including short halts. The chief factors which affect pace in marching are the size of the column, great heat, great cold, rain, snow, dusty, sandy or muddy roads, a strong head wind, darkness and steep hills ; also whether the command is composed of seasoned or immature troops. The most adverse weather conditions are high temperature, moist air and no wind.

Halts on the March.—The rules as regards halts should be elastic and regulated according

to the ground to be covered, weather, atmosphere, and the load to be carried by the men. A short halt should be made after the first half-hour's marching, and others at intervals according to the nature and state of the roads. Halts are of most value when equipment can be removed to ease the men, who should be allowed to lie down if the ground is dry, or, in the words of 'Stonewall' Jackson, "rest all over"; teams can also be unhooked. A meal should be prepared by the advance party with tea, coffee or cocoa. Temporary latrines and urinals will be required, which should be dug by the sanitary men and carefully filled in and marked before the troops resume their march. Two or three of the regulation trenches will be sufficient for each regiment. Halts should be made in the shade in hot weather, but not in stuffy hollows, halting in a chilly wind with men and animals sweating is dangerous to health. The headdress should not be removed in the sun for any length of time.

The Load of the Soldier.—The load carried by the man should be as light as possible, as it requires considerable training to even carry 20 lb. for a long day without great fatigue. At present, the total weight of a man's clothing, equipment, rifle and ammunition, etc., on field service scale, amounts to 58 lbs. Every possible attempt should be made to reduce this great

load, as the "soldier is an expensive specialist, and it is false economy to turn him into a baggage animal, which is a poor form of unskilled labour." No doubt before long motor transport will do much to lessen this load, curtail long marches and keep the troops more in touch with their supplies. It has been said by a military writer that "anything that the Infantry soldier carries which he can afford to do without for a fairly long time without serious injury to his health is extremely superfluous."

In the German, Austrian, and French Armies the mess-tin and water-bottle are made of aluminium, this effects a saving of some 2 lb. in weight. Our Army heads the list in the weight of the greatcoat, which weighs 6 lb. 13 oz., and is also very absorbent of moisture. The German greatcoat only weighs $3\frac{3}{4}$ lb., and answers the same purpose.

All nations practically, with the exception of the British, carry a shelter-tent weighing about 2 lb. to 3 lb. when in the field, but, in the opinion of some experts, the weight of this tent in our Army could be better expended on food. (See Ch. VII.)

Boots and Feet.—Attention to boots and feet on the march, especially with infantry, is one of the essentials of good marching. Every opportunity should be taken of washing the feet and applying ointments, or powders, such

as boric acid, to prevent sore feet. Every company should have a supply of this. Socks should be kept as clean as possible, and mended. The Duke of Wellington regarded boots as the most important item of the Infantry soldier's outfit in the field. Badly-made boots, largely composed of brown paper, helped to cause the breakdown of the French Army in 1870. Lord Wolseley says, "You will lose in strength from 2 to 3 per cent., according to climate, for nearly every hundred miles that are marched continuously," and this is certainly not an over-estimate under the present short-service system. The man in the ranks, towards the finish of his colour service, and in good training, may stand hard marching, but the reservist, out of condition will certainly not. Boots should be roomy, comfortable to walk or ride in, soft and watertight. Tight and leaking boots (along the seams) were the chief cause of frostbite with the Japanese troops in Manchuria.

On Arrival at Camp.—Great coats, which are seldom wanted on the march, should be got out as soon as available and put on. A hot meal should be provided at the end of a march, as waiting for baggage to arrive and dinners to be cooked in the chill of the evening is the way to get fever and dysentery. The outposts should be first provided with food, as the night's

security will depend on them. Portable soup-kitchens and boilers are of the greatest value, and much better than the brewer's van. Although the first cost is considerable, they will more than repay the outlay in extra comfort and increased efficiency of all ranks. Men should be encouraged to always carry a reserve of food in their haversacks, even if only a few biscuits, also materials for starting a fire (matches and cotton waste), and to imitate the native of Eastern lands by picking up some dry sticks before reaching camp, and so assist the cooks.

Men and animals should never be marched straight on to a camping-ground, as this is certain to cause pollution at the very outset; a halt should be made a short distance *before* reaching camp, men allowed to "fall out" and animals to stale. This is a point that is very seldom observed in practice.

Smoking on the March.—Much smoking on the march is bad for the heart and lungs and increases thirst. It should be forbidden when the pace is fast, or when marching against a strong wind, or uphill (see Ch. II.).

CHAPTER VII

THE FOOD OF THE SOLDIER—PERSONAL HYGIENE—FIELD SERVICE SANITARY ORGANISATION

1. The Food of the Soldier.—The food supply of the British soldier is a matter of the utmost importance with reference to his fighting efficiency, as he always fights better when well fed. Frederick-the-Great's remark that "an Army fights on its belly," must not be forgotten. With regard to food, nothing should be left to chance or opportunity. Insufficient nourishment directly disposes to disease by lowering the powers of vital resistance. In the field the allowance of food must be liberal. Armies have been disarmed by a deficient dietary, but never by overfeeding consequent on the establishment of a generous field service ration (see Ch. VI., *On the Line of March*).

Food is necessary to replace the waste of structure constantly going on, and to supply energy for mental and bodily exertion.

In doing work, heat is produced. The amount of this heat varies much in degree with different

forms of work and exercise, but with the body at rest, averages about 98·6° F., which is spoken of as the "normal" temperature.

Classification of Foods.—Foodstuffs may be simply divided into the following chemical classes :—

(1) *Proteids*, or nitrogenous foods.
(2) *Fats.*
(3) *Carbohydrates.*
(4) *Salts.*

The *first class* is represented by the flesh of animals, birds and fishes ; also by eggs, cheese, milk, peas and beans, etc. These are chiefly required to build up and repair the tissues of the body, such as bone, muscle, etc.

Fats are principally derived from animal sources.

Carbohydrates comprise starches and sugars. They are nearly all of vegetable origin, and are derived from cereals, pulses, potatoes, fruits, sugar-cane, etc.

Salts are contained in the different articles of food consumed and, with the exception of common salt, are not taken separately into the body.

Water makes up about 65 per cent. of the body weight, and enters largely into the composition of all articles of diet eaten in the fresh form. The following quantities of water, as

liquid, are necessary daily: at rest, 50 oz.; for ordinary work, 65 oz.; and for hard work about 80 oz. One pint = 20 oz.

In addition to the above 4 classes, with water, there are *condiments*, or substances that give flavour to food, such as mustard, pepper, etc. Salt and vinegar are also used for this purpose; and under this head may be classed tea, coffee, and many beverages, both alcoholic and non-alcoholic.

Foods have different values in proportion to the amount of energy they yield on combustion in the body; fat, bacon, butter, oatmeal, cheese, sugar and bread, in this order, stand at the top of the list.

The potential energy contained in a given quantity of any substance can be found by determining the amount of heat its complete combustion produces experimentally. The unit of potential energy, expressed as heat, is known as a *Calorie*, or heat-unit.

A diet representing a potential energy of 2,800 heat-units must always be supplied as a minimum for subsistence; 3,500 heat-units must be allowed for ordinary work, and at least 4,500 to 5,000 Calories, or heat-units, must be contained in a field service ration in order to have the best work done.

Food Consumed by an Ordinary Man.—An ordinary adult man, of average weight, requires

daily about one pound weight of water-free food in a *state of rest*, the amounts of classes (1), (2) and (3) being $2\frac{1}{2}$, 1, and 12 oz. respectively; *for ordinary work*, an addition of 2 ounces must be made to each, thus giving $4\frac{1}{2}$, 3, and 14 ounces; *for hard work*, such as military field service, another increase of 2 ounces to each constituent must be made, giving $6\frac{1}{2}$, 5, and 16 oz. respectively.

As these amounts are calculated as water-free, and as ordinary articles of solid food contain about 50 to 75 per cent. of water, the amount of solid food actually required for a subsistence, or rest diet, is about 2 to $2\frac{1}{2}$ lb., for ordinary work about 3 lb., and for hard work, from $3\frac{1}{2}$ to 4 lb. daily. In order to preserve health, a mixed diet containing a due proportion of each of the essential elements is necessary, but this must be varied according to climate and the nature of the work to be done. In hot countries more carbohydrates, represented by bread, fruit and vegetables, and less proteids and fats, are required. In cold climates the proportion of classes (1) and (2) will have to be proportionately increased to produce the necessary heat and energy.

The food required by an average man may be roughly expressed in articles of every-day diet as follows:—Beef or mutton, 9 oz.; cheese, $1\frac{1}{2}$ oz.; butter, $1\frac{1}{2}$ oz.; bread, 12 to 16 oz.;

potatoes, 10 oz.; sugar, 1 oz.; milk, ½ pint.

Rations in Barracks.—*At Home Stations* these consist of 1 lb. bread and ¾ lb. fresh or preserved meat; or 1 lb. fresh or preserved meat and 1 lb. of bread under canvas or (with the approval of the G.O.C.), when temporarily accommodated in unequipped buildings.

At stations abroad the usual scale is 1 lb bread, 1 lb. fresh meat, or ¾ lb. preserved meat. A messing allowance to each N.C.O. and man of 3d. per diem is allowed and expended under Company arrangements on the purchase of other articles, such as oatmeal, fish, eggs, bacon, milk, etc., to complete the diet. These articles are obtained through the regimental institute and shown in the Company messing book (Army Book 48). (See Para. 1159, etc., K.R.) At Home Stations, when a ration is not issued, under certain conditions a daily allowance of 6d. may be drawn in lieu. Officers are not entitled to rations at home, but during summer drills, or under other special circumstances, the issue of rations on repayment may be authorised by the G.O.C. When troops are under canvas at home, the extra ¼ lb. of meat allowed, or any portion of it, may, at the option of the C.O., be left undrawn, and the money value of the quantity undrawn may be expended regimentally in purchasing cheese.

A "Table of Equivalents" is given in Para. 28, All. Regs., when it may be necessary, or expedient, to depart from the scales laid down for home, abroad, or active operations in the field.

Field Service Ration.—In case of active operations in the field, a special scale of rations, dependent on the climate and the circumstances of the expedition, will be fixed by the G.O.C. and reported to the War Office, but the following scale will, as far as possible, be adopted as a guide :—

1¼ lb. fresh meat, or 1 lb. (nominal) preserved meat, or 1 lb. salt meat.

1¼ lb. bread, or 1 lb. biscuit, or 1 lb. flour.

⅝ oz. tea, ¼ lb. jam, 2 oz. sugar, ½ oz. salt, $\frac{1}{36}$ oz. pepper.

½ lb. fresh vegetables, or 2 oz. dried vegetables, or 4 oz. preserved fruit.

$\frac{1}{320}$ gall. lime juice ($\frac{1}{10}$ gill), with ¼ oz. sugar, on days when fresh vegetables are not issued ; $\frac{1}{64}$ gall. rum (½ gill) and tobacco, not exceeding 2 oz. per week, for those who smoke ; the issue of lime juice, rum and tobacco being at the discretion of the G.O.C., on the recommendation of the medical officer (see also Ch. IV., Scurvy, and Chs. I. and VI.).

The bread in this ration, instead of being "standard" bread, is often replaced by hard biscuits, difficult to chew and digest, and the

meat often consists of preserved or tinned meat, which is food in a very concentrated form, deficient in fat and liable, when used for any length of time, to upset the stomach and favour abdominal disease, such as Enteric Fever and Dysentery.

On active service the following alternate issues may be made :—

(*a*) At the discretion of the G.O.C., ¼ lb. biscuit may at any time be substituted for ¼ lb. meat on the days preserved meat is issued.

(*b*) When bacon and cheese are available, ¼ lb. bacon, or 2 oz. cheese, may be substituted for ¼ lb. meat. This substitution of bacon and cheese for part of the meat ration gives more variety and supplies a natural craving when hard work has to be done. In the American Army, bacon always forms a part of the service ration ; it helps the men to eat the bread or biscuits, is easily cooked, and supplies a large amount of fat in an agreeable form.

A larger amount of sugar in the form of jam is also required, in addition to a *daily* issue of bacon and cheese.

Rations in Billets.—Under certain conditions, rations in money or kind will not be admissible ; these include the days on which soldiers are provided with a hot meal by an innkeeper in billets. Such issues are limited by the Army Act to the first three days (including the day

of arrival) in billets at any one place (para. 19, All. Regs). The price allowed for breakfast, dinner, and supper under these conditions is 1s. 6d. (see Army Act, S. 106, and Schedules).

Preserved meat, generally obtained from the Colonies or America, is prepared by the meat, deprived of bone, being exposed to a very high temperature for some hours in iron tins (sterilised). Finally, the small hole, or holes, left in the soldered tins for the escape of air and vapour are carefully sealed.

Ptomaine Poisoning.—This form of poisoning results from eating decomposed food, and is specially likely to occur when preserved rations are used. For this reason, all tins containing preserved food should always be carefully inspected to see that the contents are fit for consumption before issue. As previously mentioned, cooking does not render decomposed food safe to eat.

All tins that are much rusted, indented, or which show perforations by nails, or bulging of the sides should be at once condemned.

The sides of a tin of preserved beef, for instance, should always be slightly concave, or drawn in, from the partial vacuum which exists inside. If putrefaction of its contents has taken place, the sides will be bulged, or "blown," as it is called, from the gas produced inside.

The soldering of the tin should be complete, and when opened the contents should adhere closely to the inside, and have no unpleasant smell. It has been recommended by a recent Army Committee that tins should be painted and not lacquered ; that no paper labels should be used, as these became damp and cause rust and corrosion of the tin ; and that all tins should have the date of issue stamped on the tin. During peace, preserved rations, meat and biscuits, are now only issued about once a month to turn over stock. Preserved meat is in 1 lb. tins.

Food Carried in War.—In the field the soldier only carries on his person (1) the unexpended portion of the day's ration issued the previous evening, and (2) an "emergency ration," weighing 6½ oz. net, or 9½ oz., with the tin. The first is difficult to estimate, but may be put down as 12 oz. bread, 6 oz. meat, and 2 oz. of groceries, as a maximum, which, with the emergency ration, gives the total weight of food carried by each man as under 2 lb.

One day's bread and meat ration is also carried in the regimental transport, one day's bread and meat ration in the transport and supply columns, and three days' bread and meat ration in the transport and supply parks, or 5½ rations altogether (see pp. 42 and 68, F.S. Pocket Book).

The emergency ration is made of chocolate, with added proteid, and put up in hermetically sealed tins and carried in the haversack by each soldier. It is to be produced at inspections, and never to be eaten except by the order of an officer, or when in extremity. The contents of each tin are calculated to maintain strength for 36 hours.

The Issue of Rum.—The experience of war is against the routine issue of alcohol in the form of spirit as a ration. Formerly, rum was a daily issue in the Army, and was supposed to be a preventative against Malaria and other diseases.

Alcohol should only be issued after a long day's march, or in cold and wet weather, and never on the march or during the heat of the day. Red wine, instead of rum, would probably be better, and is said to act as an intestinal antiseptic, but is bulky for transport, and British soldiers, unlike Continental troops, are unaccustomed to its use, and prefer beer when it can be obtained. The best way to issue rum to the men at the end of a tiring march is with hot water and sugar, in the form of punch, which increases its stimulating effect very much. (See Ch. II., *The Abuse of Alcohol.*)

Cooking.*—As late as 1857 each company in the British Army was provided with two

* See Appendix A, p. 157.

boilers, in one of which the men boiled their meat, and in the other the potatoes. A soldier ate this diet from the date of his enlistment to his discharge, living on boiled meat, if he completed his service, for twenty-one years.

The general quality of the provisions supplied to the Army at present is good, and cooking has been very much improved in recent years, thanks to the School of Army Cookery at Aldershot (see Para. 763, K.R.).

Food should be plain, wholesome, well-cooked, and served up in an appetising form. It is necessary to have variety in food, especially on service, when the diet is often extremely monotonous and extra articles cannot be obtained. Monotony of diet on field service itself predisposes to disease. (For Camp Cooking, see p. 36, F.S. Pocket Book, and Manual Field Eng., 1911, Sec. 59 and 60.)

2. Personal Hygiene.—Personal cleanliness may be divided into (1) *cleanliness of the body*; (2) *cleanliness of the clothing*, and both have been referred to in other chapters (see Ch. VI., *Baths and Bathing*, etc.). The maintenance of cleanliness of the person and clothing of the soldier demands constant watchfulness on the part of company officers. Individuals of careless or slovenly habits are usually recruits, and so special attention should be given to them until they acquire proper

habits. As expressed by Woodhull: "Dirt that is hurtful is not the mud of the highway or field, nor the dust of the parade ground caught on the outside of the boots and clothing; it is the cutaneous (skin) debris mingled with dust and dissolved in perspiration, soaked into the underclothing, organic dirt that offends the nose as well as the eye, that depresses the subject and may poison his comrade."

In other words, the cleanliness of a man's body and underclothing is more important, from a health point of view, than spotless uniform, the polish of buttons, pipeclay, etc.

Clothing. (For Bedding, see Ch. VI.) Army clothing is divided in a most puzzling way into

(1) *Public* clothing, not the property of the soldier, such as the great-coat and helmet;

(2) *Personal* clothing, which includes service dress, boots, etc., and

(3) *Necessaries*, which include underclothing.

Each Infantry recruit on joining gets issued with 2 pairs woollen drawers, 3 flannel shirts (grey-back), 2 pairs worsted and 2 pairs cotton socks, etc. These articles are generally of good quality although too heavy in the summer. They require to be carefully washed in luke-warm (not boiling) water, and kept properly mended.

The custom in some units of allowing the men to purchase and wear other underclothing, and even boots, is not to be generally recommended. For the upkeep of personal clothing and necessaries, a quarterly allowance, amounting to about 34s., is now given, and varies somewhat according to rank, corps, etc. All articles to replace kit are supplied from Government stores at published prices. Each man contributes from his pay about ½d. per day for washing.

All clothing, as far as possible, should be washable, easy fitting, not too heavy, and made of wool. The present infantry trousers worn with putties are uncomfortable and cause much injurious pressure on the legs. It would also be advisable to have the outer garments, such as service dress and great-coat, waterproofed.

Many men in barracks wear the same underclothing day and night, which is not hygienic, and some other arrangement might be possible. *Sleeping suits* are issued free to troops stationed at Hong Kong, Singapore, Ceylon, Jamaica, and Sierra Leone only.

Canvas suits are issued to recruits for use on fatigue duties of a dirty nature, and are very necessary to save the khaki service dress from becoming unduly soiled.

Care of the Mouth and Teeth.—As bad teeth are productive of much inefficiency and disease,

especially on service, tooth brushes and tooth powder are necessary to keep the mouth and teeth clean, and should be daily used by all N.C.O.'s and men.

Each recruit is now issued with a tooth brush, and he should be encouraged to use it in the legitimate way, and not for cleaning his buttons, or simply to show at kit inspections, as is often the case. A tin of tooth powder, such as "Calvert's Carbolic Tooth Powder," should be purchased by each man, and will last for months. In the French Army tooth powder is issued free, and the cleanliness of the mouth is considered to be of great importance.

Hair.—Hair should always be kept cut short, for the sake of cleanliness as well as of appearance (see Para. 1695, K.R.).

Care of the Feet.—A daily foot bath under all circumstances is desirable to keep the feet in proper condition. Water does not make the skin of the feet tender; but on the contrary, hardens it, and helps to prevent blisters, corns, sore feet, etc. With Infantry, great attention should be paid to the feet, socks and boots, as without it good marching for any distance is impossible. In the German Army, company officers inspect the men's feet and foot-gear twice a week in barracks and more frequently on the march. In recent years, regimental chiropodists have been appointed, with 6d.

per day 'additional' pay, to render assistance in the matter of sore feet, corns, etc., but of all forms of treatment for the feet of the soldier cleanliness is the most important (see Para. 1201, K.R., and Ch. VI., *Boots and Feet*).

3. Field Service Sanitary Organisation.—*General Organisation.*—The Commander of every unit and formation is responsible for the sanitary condition of the quarters or localities occupied by his command, and for taking all measures necessary for the preservation of the health of those under him. He is also responsible for seeing that each officer and soldier observes all sanitary orders, and for the good order and cleanliness of that portion of a quarter or locality under his charge, irrespective of the period for which the latter may be occupied.

The Director of Medical Services (*D.M.S.*) is the responsible adviser of the C.-in-C. on all medical and sanitary matters. His representatives are similarly the advisers of the commanders to whose headquarters they are attached.

There is an *Administrative Medical Officer* (*A.M.O.*) with the headquarters of each Division of Cavalry and Infantry, who commands the R.A.M.C. of the Division, and who has an Assistant M.O., chiefly for sanitary duties. A M.O. is also attached to every large unit.

The Personnel of the Sanitary Service comprises :—

(1) *The regimental sanitary organisation of field units.*

(2) *The sanitary organisation on the L. of C.* (lines of communication).

(3) *The sanitary inspection committee.*

(1) **The sanitary service of field units** is organised upon the principle that every unit, through its commander, is responsible for its own sanitation and for the sanitary condition of any area which it may occupy. For this purpose each unit is provided with a regimental sanitary detachment, drawn partly from the ranks of the R.A.M.C. and partly from the ranks of the unit itself. The establishment of regimental sanitary detachments is given in War Establishments.

Example.—An Infantry battalion has attached for water duties, etc., 1 corporal and 4 men of the R.A.M.C., and has 1 N.C.O. and 8 men trained in sanitary duties (see W.E., page 82, etc., Remarks (*a*) and (*g*)).

The Duties of the R. A.M.C. personnel of the detachment are :—generally to supervise and purify the drinking water supply, and to take charge of all apparatus and stores connected with the water supply of the unit ; to supervise the use of disinfectants in camp or quarters

as may be necessary; to look after the sick of the unit until they are removed to hospital, including the immediate removal and segregation of all cases of infectious disease, and, if necessary, of "contacts."

The duties of the sanitary personnel of the detachment provided by the unit are, generally, to act as sanitary police in order to prevent soil pollution, and, in detail, to supervise:—

(1) The preparation and care of latrines and urinals, including the filling in of the same, and marking of old sites.
(2) The systematic collection, removal and disposal of refuse by burning or otherwise.
(3) The construction of ablution places and the disposal of waste water.
(4) The sanitation of cooking places, horse and mule lines, and slaughtering places in the area occupied by the unit.

(2) Sanitary Organisation on the L. of C.—The sanitary service of the L. of C. is organised on a more permanent basis than that for field units, and comprises sanitary officers, sections and squads. The personnel of *sanitary sections* and *squads* is found from the R.A.M.C. and supplemented by such hired civilian labour as can be procured.

For purposes of sanitary administration the

L. of C. is divided into *sanitary districts* and *posts*. As a rule the base, railhead, and any specially important part will constitute a separate sanitary district.

A specialist sanitary officer is appointed to each district and a sanitary section allotted thereto to form the nucleus of a sanitary establishment. To each post a *sanitary squad* is allotted, and may from time to time be added to as local circumstances may demand.

The duties of a sanitary officer in charge of a district are analogous to those of a M.O. of health, and include the supervision of food and water supplies, the disposal of sewage and refuse, disinfection, and all measures necessary to prevent the introduction and spread of infectious disease.

Personnel of Sanitary Sections and Squads.—*A sanitary section* has 1 officer, 2 sergeants, 23 rank and file; total, 26. *A sanitary squad* has 1 sergeant, 5 rank and file; total, 6.

A sanitary squad will be required for each road or railway post on the L. of C., and two sanitary squads for each advanced depot. Sanitary squads will be attached to sanitary sections as may be ordered. Road posts are usually separated by 10 miles, railway posts by 25 miles.

The responsibility of the O.C., a section or post on the L. of C., with respect to sanitation,

is analogous to those of the O.C. a unit. (See page 27 and Pl. I., F.S. Pocket Book.)

The duties of a sanitary squad are as follows :—

(1) To execute skilled work in connection with disinfection, the provision of pure water, including its collection, distribution and storage, construction of incinerators, etc.

(2) One or more of the men will be specially detailed to supervise the work of perment fatigue parties employed for conservancy or other work in connection with sanitation.

(3) To act as sanitary police. For this purpose the N.C.O. and men of the squad are invested with the authority of military police, and wear a police badge.

(4) If the post has a railway-station under military control, the squad exercises sanitary supervision over the water supply to the troops passing through, and over the conservancy arrangements generally.

Sanitary Service at the Base.—This is in charge of a specialist sanitary officer, who may, especially if the base includes a large seaport, be aided by one or more assistant sanitary

officers. He is entrusted with the duties of port sanitary officer, with a view to preventing the introduction of infectious diseases from transports; he arranges for the segregation of cases of infectious disease and of "contacts," when this last measure is considered necessary.

(3) **The Sanitary Inspection Committee.**—On mobilisation being ordered, a sanitary inspection committee is formed, composed as follows:—

A regimental or staff officer (probably of the rank of colonel), as president, a field officer R.E., and a field officer, R.A.M.C., as members. The committee receive the instructions of the C.-in-C., through the Director of Medical Services.

Duties of Sanitary Inspection Committee.—The duties of this committee are:—

(1) To assist commanders and the medical service in their efforts to maintain the health of the Army, not only by co-ordinating the work of the different military branches, but also by co-ordinating the military with the civil sanitary organisation of the country or the area occupied.

(2) To initiate important schemes of general sanitation, and to serve as a board of reference for the solution of sanitary problems.

(3) To visit and inspect stations occupied by troops, to advise local authorities regarding necessary sanitary measures, and to further in every way the maintenance of satisfactory sanitary conditions, reporting to the D.M.S. any measures they consider necessary, but which they cannot arrange to be carried out locally.

(4) To ascertain what sanitary appliances and materials of all kinds are required for the Army, and that an adequate reserve is maintained.

For further information, see [F.S. Reg., Part II. (1909), S.S. 70 to 73.

APPENDIX A

MAJOR A. R. BURROWES, 1st Battalion Royal Irish Fusiliers, Shorncliffe, has kindly furnished me with the following specimen Scale of Diet and explanatory notes :—

1ST BATTALION ROYAL IRISH FUSILIERS.

SCALE OF DIET FOR WEEK ENDING 18TH NOVEMBER, 1911.

Sunday : Breakfast—Bacon and Tomatoes ; Dinner—Roast Beef, Baked Potatoes, Butter Beans ; Tea—Butter.

Monday : Breakfast—½ Butter, Quaker Oats, and Milk ; Dinner—Curry Stew, Potatoes, Currant Rolls ; Tea—½ Butter and ½ Raspberry Jam.

Tuesday : Breakfast—Fried Fish, ½ Butter ; Dinner—Baked Meat, Steamed Potatoes, Plum Pudding ; Tea—Butter.

Wednesday : Breakfast—Haddocks and ½ Butter ; Dinner—Cold Roast Mutton, Pickles, Steamed Potatoes, Bread Pudding ; Tea—Butter.

Thursday : Breakfast—Sausages ; Dinner—Baked Meat, Steamed Potatoes, Apple Rings and Rice ; Tea—½ Butter and ½ Plum Jam.

Friday : Breakfast—Fresh Herrings, ½ Butter ; Dinner—Brown Stew, Steamed Potatoes, Suet Pudding with Syrup ; Tea—Butter.

Saturday : Breakfast—Baked Mackerel if procurable, ½ Butter ; Dinner—Boiled Beef, Steamed Potatoes, Carrots and Onions ; Tea—Butter.

Hot Soup at Cookhouse, 6.30 to 7 p.m. daily, Sundays excepted.

Scale of Potatoes, 80 lbs. per 100 men ; Bacon, 1 lb. per 4 men ; Haddocks, 1 lb. per 2 men.

NOTES.

i. ½ Butter refers to scale on page 2, A. Book 48.

ii. Charge to soldier per diem ... ... 3½d.
From Regimental Funds, per diem... ½d.

Total ... ... 4d.

iii. From 600 to 900 lbs. of dripping is saved each month which is not used in cooking ; this is sold at 3½d. per lb.

iv. 12s. 6d. per 100 men is received monthly for refuse (£3. 10s. received for October, 1911).

v. Two dinners can be made out of an issue of preserved meat.

vi. A large quantity of biscuits is not eaten when issued, and is afterwards made into puddings.

vii. The whole battalion has the same diet sheet; this is found in practice to be the most satisfactory.

The object aimed at is :—

1. Different diet each day.
2. Good plain food.
3. PLENTY of it.
4. Well cooked.

APPENDIX B

Papers set at Examinations for Promotion —Subject (*j*) (Sanitation), Lieutenants to Captain.

(*Time allowed, three hours.*

Total marks, 400.)

MAY, 1908.

1. Define the term "sanitation," and explain the range of topics which its consideration embraces. (50 marks.)

2. From your knowledge of military history, give three instances where the appreciation or non-appreciation of the importance of sanitary effort has affected military operations. (50 marks.)

3. What are the factors favourable to the origin and spread of diseases among soldiers in a field force? Explain on what lines all efforts for the prevention of disease among soldiers must be developed. (50 marks.)

4. Enumerate the ordinary sources of water supply, and in respect of each state what you consider to be its advantages or disadvantages as a source of wholesome water. Give your reasons. (50 marks.)

5. Among troops serving in India, two diseases are notoriously prevalent, namely, Enteric Fever and Ague or Malaria. Give your views as to why these diseases are so common, and explain the lines on which they can be prevented to a large extent. (50 marks.)

6. Assume that you are in command of 50 men thrown forward, during field operations, to hold a small post, covering a ford over a river, for a few days. You have no medical officer with you, only a sergeant and two men of the Medical Corps, provided with the minimum of medical and surgical necessaries. Give in detail the precautions you would take, and the orders you would issue to safeguard the sanitation of the party and the place under your command. (60 marks.)

7. Write a short account of the scheme of sanitation for field service which existing regulations authorise, on the mobilisation of a field force. (90 marks.)

———

NOVEMBER, 1908.

1. Discuss the sanitary aspects of recruiting, and the physical training of the young soldier. (80 marks.)

2. Explain how far locality, age, and length of service influence the prevalence of disease among soldiers. If possible, support your statements with statistical evidence. (80 marks.)

3. Enumerate the chief preventable diseases occurring among soldiers, and, in respect of any three of these diseases, outline the essential means of prevention. (80 marks.)

4. Describe the construction and working of a filter for the purification of water. In the absence of a special filter, how could you improvise an apparatus for the clarification of muddy water? What diseases commonly result from the use of impure water? (80 marks.)

5. Assume that you are detailed to give a short address to some men on the sanitation of the march; give a summary of the points which you would discuss for their instruction. (80 marks.)

MAY, 1909.

1. Enumerate the various ways in which disease germs enter the body, and describe how they produce disease in the body. (80 marks.)

2. Give as fully as possible what you know about Malta Fever, especially as regards the cause of this disease, and the steps necessary for its prevention. (80 marks.)

3. How is the purification of water effected? Describe fully any one method of purification. (80 marks.)

4. What do you understand by the word "ventilation," and how is it normally carried on in a room? Mention any disease which has been especially associated with overcrowding and bad ventilation of barrack-rooms. (80 marks.)

5. What are the three main objects to which attention should be directed in the field in the matter of sanitation? What establishment is at the disposal of the commanding officer of a unit to enable him to attain these objects? (80 marks.)

DECEMBER, 1909.

1. What is the cause of Malarial Fevers, and how does this cause enter the body? What are

the most efficacious means for the prevention of Malarial Fevers? (80 marks.)

2. What are the conditions affecting sanitary measures on the lines of communication and at the base, and what is the organisation designed to deal with these on active service? (80 marks.)

3. Under whose charge are latrines and urinals in barracks? What are the general rules for the proper care of these? (80 marks.)

4. How are camp sites chosen, and what are the points that have to be taken into consideration in their selection? Name some conditions that would render a site unsuitable. (80 marks.)

5. What are the most common causes of men falling out on the march, and how are these brought about? Why do men fall out more frequently on a hot day than on a cool day, and how may this be prevented? (80 marks.)

MAY, 1910.

1. What are the two forms of Dysentery and to what are they respectively due? How do the causes of Dysentery pass out of, and enter, the body? (80 marks.)

2. How is Yellow Fever spread? What measures should be taken to prevent this disease? Do you know of any actual instance of these measures having been taken and having proved successful? (80 marks.)

3. What sanitary establishment will a commanding officer have for the purpose of enabling him to maintain the health of his command? Describe briefly the duties of the various members of this establishment. (80 marks.)

4. What are the effects of alcohol on the human body? When may it be advantageous to order an issue of alcohol? (80 marks.)

5. How is the ventilation of a room normally carried on? What is the reason for the regulation laying down that each man should have 600 cubic feet of space in a barrack-room? What is the readiest test of the efficiency of the ventilation of a room? (80 marks.)

DECEMBER, 1910.

1. In what way do you distinguish between the predisposing and the actual cause of a disease? What is the actual cause of Enteric Fever? Name also some of the more common predisposing causes. (80 marks.)

2. What is Malta Fever due to, and how is it spread? In what manner may it be prevented? (80 marks.)

3. What is the cause of Scurvy, and in what way does this disease differ from Enteric Fever, Cholera, and similar diseases in this respect? How can it be prevented? (80 marks.)

4. Describe briefly the system of purification of water by means of the regulation filter water-cart. (80 marks.)

5. What are the advantages and disadvantages of tobacco when issued to the troops? (80 marks.)

MAY, 1911.

1. What are the factors present in an Army in the field which favour the origin and spread of Enteric Fever, Dysentery, and kindred diseases? (80 marks.)

2. What are the chief predisposing causes of Plague, and what animals are connected with its spread? How does the connection of these animals with the disease affect the question of prevention? (80 marks.)

3. Enumerate the three different methods by which water may be purified. How do they

differ from each other in their method of action? What do you understand by the expression "heat exchange apparatus," and in what positions would such apparatus be useful in the field? (80 marks.)

4. What is the cause of Malarial Fevers, and how may they best be prevented? (80 marks.)

5. What is meant by ventilation, and how is it ordinarily effected? (80 marks.)

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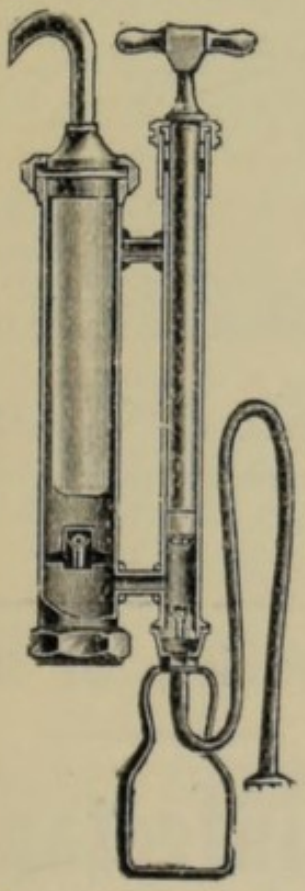

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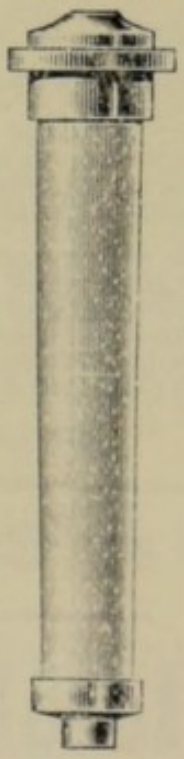

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