A BRIEF REVIEW OF THE PROGRESS OF MILITARY
HYGIENE SINCE THE WAR.

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I hope that during this Session we shall have before us many interesting papers for discussion, and we should, I think, bear in mind that one of the objects of the group is to exchange freely our views on matters affecting the welfare of the fighting services, and that in peace we should prepare for war by endeavouring to obtain a clear conception of the best and most approved methods of sanitation and should apply all new scientific data to the requirements of active service in the field. The marvellous progress in the theoretical knowledge of hygiene was to a great extent in the late war followed by a manifold practical application in every branch of the science, and it is well known how through this advance we surpassed all earlier efforts; but even so there always remains the feeling that possibly more might have been done in spite of all our efforts. The prevention of disease means looking ahead, and our aim should be to anticipate the many problems which arose during the past war and think out the new ones which will appear on active service in the field under the advancing conditions of warfare.

It is clearly then our duty to try and visualize future operations and be prepared to reduce our shortcomings to a minimum, and this, I feel sure, can be materially assisted by the deliberations of our group so happily constituted.

The methods which we adopt in attaining the solution of our problems will be based on our scientific work and the experience gained in the late war will still form a sound basis for future action, just as the limited experience gained in the South African War served us in such good stead during the last war and gave rise to the foundation on which our sanitary organization was built.

In the "Medical History of the War" we have now at our disposal a more or less complete summary of the measures of prevention undertaken in all theatres of the war. This work undoubtedly will be of the greatest assistance in helping us to formulate our plan of campaign in the future. For this most valuable help we are indebted to our late president, who as editor-in-chief of the "Medical History of the War" has spared no pains to produce a record of which he may be justly proud.

In addition to extending our own outlook we must ensure also the education of the whole personnel of the Services in all matters concerning...

1 Presidential Address read at the opening meeting of the new Session of the Army, Navy, and Air Force Group of the Society of Medical Officers of Health, November 30, 1923.
A Brief Review of the Progress of Military Hygiene

Hygiene and sanitation in so far as it affects life in the field. This education of the sailor or soldier must be thorough—more in harmony with modern scientific progress and such that ritual becomes a matter of daily routine. The subject has specially occupied our attention since the war, and all officers and men are receiving instruction in hygiene at the Army School of Hygiene at Aldershot. An attempt is made to produce a hygienic conscience and to a certain extent faith must take precedence over knowledge.

Although naval or military hygiene may necessarily differ to some extent from that under civil conditions, especially in its application in the field, yet in principle it in no way differs from general hygiene, and hence the value of our group is not limited to the fighting services alone. Army hygiene is often of special value to the Civil Public Health Service, since ideal experimental conditions are facilitated in service practice and in field sanitation, and certain problems can be studied more freely and to a greater extent, perhaps, than would be practicable under civil conditions. Again, in the Service, continual observation of the sailor or soldier and his family, widens our views on epidemic problems. Measures directed against outbreaks of infectious diseases are also facilitated in the circumstances attending life in the Service, and the control of environment can be more thorough and systematic than is often the case in civil life. Such measures as isolation, the daily examination of contacts, increased spacing out in sleeping quarters, disinfection of messing utensils, and preventive inoculation, are examples of measures which should present little difficulty in our Services.

It is generally recognized that the exercise of Army discipline does much to facilitate the application of hygiene measures, and in consequence, the health conditions of a unit are directly proportional to its discipline. The best disciplined regiments for example show the lowest sick rate.

In the Services, the chief function of the hygiene authorities is to advise on all measures of health affecting the troops, but it is only by the interest and co-operation of regimental officers, especially company officers, that the best results in the prevention of disease can be obtained. The value of hygiene in the prevention of wastage of man power, not only in peace, but more especially in the field, is recognized by all branches of the Army and the interest taken and the assistance given, by the General Staff and other branches, not only make the task of the medical authorities easier, but tend to infuse the right spirit of hygienic discipline and precept throughout the Services.

On many occasions during the war, medical officers of foreign armies commented on the fact that in the British Army hygiene measures were greatly facilitated, not only by the interest and assistance afforded by all combatant officers, but also by the training in hygiene and sanitation, which officers and men had received prior to the war and continued to receive even during the stress of the intensive training of the new armies.
The knowledge gained in the Services by observation carried out in all parts of the world, is naturally of great interest to the civil hygienist, and indeed, co-operation between the civil, naval and military services has been the means of elucidating many an obscure problem, resulting in a general benefit to the nation. It is only by such mutual confidence and co-operation that any real progress can be made, and it is obviously to the advantage of both civil and military preventive services to foster this in every way.

It is also essential to success that, in addition to a close co-operation among all the Regular Services, the Auxiliary Services should as far as possible keep themselves in close touch with all hygiene movements and measures of control which are carried out in the Regular Army both at home and abroad.

It is likewise an advantage to keep ourselves informed of all recent advances in military hygiene made by foreign powers. The official publications of the American and French military medical departments are particularly interesting and instructive.

Time is bringing the fulfilment of many a recommendation made by medical officers and others in the past, and doubtless many of the improvements we so earnestly desire will be eventually made, even though we may not live to see them.

All measures for the improvement of health or the prevention of disease are more or less costly, and no financial branch of the public services can view a hygienic innovation dispassionately, unless it is shown that ultimately a gain in economy will be effected by improvement in general health. It is the duty, however, of the medical authorities to bring to notice any measure which they believe, after due consideration in all its aspects, to be necessary to preserve or improve the health of the troops, even though the recommendation cannot be carried out at the time, because of financial or other difficulty.

The record of the recommendation should always be at hand, to be returned to again and again until fulfilled, and very often a part of the recommendation, or some modification of it, which will eventually bring about the completion of the whole, may be carried into effect.

Since our group consists of members, all interested in the public health aspect of the fighting Services, to many of whom we shall look for help and advice when occasion arises, possibly it will be advantageous to remind you of certain problems that have arisen since the war, and to inform you of the progress which has been made for the betterment of the soldier in regard to his personal welfare and efficiency. Although much has been done and is being done, still many problems remain, some of which for reasons of economy are held over at present, but eventually they must be solved. In this respect, bearing in mind that a very large amount of disease can now be attributed to overcrowding, I feel that the problem of increased space per head in barrack rooms, combined with better lighting
and ventilation, can still profitably occupy our minds in the future, and that we have by no means solved the difficulty of preventing overcrowding on active service, or the all-important problem of ensuring cleanliness and freedom from vermin in the field.

Public health, as applied to the civil community, is concerned with the individual during the whole period of life, but in the fighting Services it is chiefly concerned, for all practical purposes, with selected personnel during a certain period of life. Practically, and as it should be, it is the best and most active period (from 18 to 40 years of age) with which we are chiefly concerned.

In this short address it will only be possible to mention some of the progress which has been made since the war under two headings:—

(1) Recruiting and enlistment.
(2) Service at home and abroad.

(1) Recruiting and Enlistment.

Recently the whole of the duties connected with the medical aspect of recruiting have been taken over by the Directorate of Hygiene. By this administrative change, the Directorate of Hygiene is not only responsible for the preservation of the soldier’s health, but also from a health point of view, for his selection and training as a recruit.

It is not necessary for me to dilate upon the importance of this new burden of responsibility which has been added to a scientific branch of the Army Medical Service; it should suffice when I tell you that so long ago as the middle of the seventeenth century both the Prussian and the Austrian Army Regulations emphasized the fact that “The duty of inspecting recruits and defining whether they are fit or unfit for military service is the most difficult and responsible that an army surgeon has to perform.”

At the present time, the man power of the country is suffering from the effects of a long continued war, much in the same manner as did the French after the general peace in 1826. In that year out of 1,033,442 soldiers drafted to serve in the Army, 380,213 were sent back because they fell short even of the diminutive stature of sixty-one inches.

Our difficulties at the present time are not connected so much with the stature, but with the general physique and minor disabilities from which so many of the recruits are suffering when they present themselves for enlistment. In this connexion, I would draw your attention to the fact that the percentage of medical rejections on enlistment increased roughly from twenty per cent in 1912-13 to thirty-five per cent in 1920-21, and the present day rate of rejection is even higher.

The medical branch is not concerned, except in an advisory capacity, with fixing the limitations of age and height for a recruit; these are, and always have been, governed by the supply of and demand for recruits. It is important to remember, however, that whilst the youth of from 18 to
20 is more easily moulded to the requirements of a trained soldier, a youth never becomes really efficient as a fighting man until after the age of 20 or 21. The memorable remonstrance of the Emperor Napoleon to the legislature of France should not be forgotten. “Shame on you!” he wrote. “I demand a levy of 300,000 men; but I must have grown men. Boys serve only to fill the hospitals and encumber the road-sides.” The vast number of immature conscripts who gave out on long marches during the campaigns of the French Emperor, and particularly during the march to Moscow, is well known.

In dealing with the subject of recruiting, it is interesting to consider the statistics relating to the disabilities for which recruits are rejected. The most common cause for rejection in previous days was “Diseases of the Heart” and whilst the percentage of rejection from this cause has not increased to any great extent there has been a marked increase in the percentage of rejections for disabilities which may be attributed to, or be connected with faulty nutrition and development, possibly the result of the war. I refer to defective vision, defective and deficiency of teeth, under-chest measurement, and flat feet.

The increased strain on the nervous system consequent on the “frightfulness” of modern warfare has led to a greater amount of attention being focused on the mental capacity and nervous stability of the recruit on enlistment, as a possible means of lessening the incidence of shell-shock and allied war neuroses. To this end, investigations are at present being conducted to try and establish a standard of mental capacity for the recruit on enlistment and at the same time a War Office Committee is dealing with the subject of Disordered Action of the Heart. It is hoped that by the provision of a standard of normality as regards the tolerance of the heart to exercise, to lessen the discharge of recruits under this head. Researches are being continued, so as to arrive at more definite standards of physical normality, more especially with regard to the normal ratio of weight to stature, and the relation of body weight to the economic load which the soldier can carry.

I will not burden you with a mass of figures dealing with the statistical results of recruiting, but the brief reference I have made to what is being done may give you an idea of some of the problems connected with the medical aspect of recruiting.

Depot Training.

A recruit who is passed medically fit at a recruiting depot and after final approval by the approval officer, joins his regimental depot for what is perhaps the most important phase in his career as a soldier. At this depot he receives a further medical examination to ensure that no disabilities have been missed at his primary medical examination which are likely to interfere with his future efficiency as a soldier. He remains at the regimental depot for approximately five months, during which period
he is under constant medical supervision by the medical officers in charge of effective troops, and at the same time is periodically inspected by the Assistant Director or Deputy Assistant Director of Hygiene, who is able to scrutinize very closely his hygienic surroundings, his food, clothing, physical training, and in fact all details which combined make an ideal system for producing a trained soldier from the raw recruit in the shortest period possible. Particular attention is paid to the systematic weighing of the recruits whilst at their training; and any recruit who loses or fails to gain weight whilst at the depot is very carefully medically examined for the cause. It is interesting to note that the generally accepted idea that a normal recruit loses weight during the first fortnight of his training has been exploded. It has been proved recently that the normal recruit steadily gains weight during his twenty weeks period at the depot; the average increase being in the neighbourhood of ten pounds. Admissions to hospital are followed invariably by a drop in weight commensurate with the degree of sickness, and curiously enough, absence without leave, involving in all probability excesses of one nature or another, generally is followed by a drop in body weight. Furthermore, investigations are proceeding in conjunction with the physical training branch, the result of which it is hoped will facilitate the elimination of the nervous unstable recruit from the ranks of the trained soldier. In this connexion I would emphasize the importance of endeavouring to train the recruit in the "unknown quantity" of modern warfare.

The period spent at the depot is all too short, but at present it has to be controlled by the demand for overseas drafts, and as a contrast, I would draw your attention to the lengthy period of probation which recruits for the Roman army had to undergo before they were finally approved.

This period according to Vegetius was of four months duration, and even then the recruit did not receive the military rank of a soldier until he had satisfactorily proved that he had the necessary physical ability, mental capacity and courage to endure the hardships and dangers of a soldier's life.

(2) Service at Home and Abroad.

In the first place let us consider what part the Directorate of Hygiene plays in the service of the soldier during his whole career in the Army.

The Directorate is concerned with all matters relating to the preservation of health and the prevention of disease. Collection of information as to the prevailing diseases, water supplies, geology and meteorology of possible theatres of war, and formulation of preventive measures and suggestions as to suitable clothing, dietaries, etc. Medical questions and statistics in connexion with recruiting; Medical and sanitary questions in connexion with barracks, hutments, hospital ships, water supplies, and methods of purification; schemes for the disposal of waste water, refuse, and excreta. Technical questions as to disinfectors and disinfectants; food requirements of the soldier; clothing and equipment. Consideration of
inventions dealing with the prevention of disease and advice on the supply of materials. Organization and direction of research on matters affecting the health of the Army. Liaison with public health departments at home and in foreign countries.

It also maintains a close co-operation with the Directorate of Pathology, since the prevention of disease is from a scientific point of view intimately dependent on mutual investigation in pathology and hygiene.

In regard to all questions affecting accommodation in barracks and camps, we should recall the wonderful and valuable recommendations made by the Royal Commission appointed in 1857 to inquire into the Regulations affecting the Sanitary Conditions of the Army. This report, in spite of the lapse of time, still repays a close study and should be read by all interested in the subject. Personally I find a reference to it of the greatest value, and for sound common-sense principles as applied to barracks and general sanitation it cannot be surpassed.

The outcome of the recommendations made and carried out was to reduce the death-rate from 17.5 per 1,000 in 1857, which was then double that of the civil death-rate, to 3.4 in 1897, and to 2.2 at the present day. In 1882 the Commission was constituted a standing body and had its counterpart in the Army Sanitary Committee, appointed after the Crimean War, and by the Army Hospitals Committee which was formed in 1903. These two Committees were amalgamated in 1906 as an Army Hospital and Sanitary Committee and it was this Committee which was absorbed in the Army Medical Advisory Board in 1907. To this Board was attached an expert in sanitation and an expert in tropical diseases.

The Board decided that two sub-committees should be appointed to carry out investigations of various matters connected with the work of the Board, more especially as regards the prevention of disease. These sub-committees were termed Pathological Sub-Committee and the Hygiene Sub-Committee.

The Board also appointed the following sub-committees: Sanitation, Construction of Barracks and Hospitals, and Equipment (including Clothing and Ambulance Transport).

On the outbreak of war in 1914, the Army Sanitary Committee was reconstituted in November of that year to advise on all matters connected with the health of the Army at home and overseas. It consisted of representatives of the Local Government Board, India Office, and the civil and military sanitary experts of the Army Medical Advisory Board.

The present Army Hygiene Advisory Committee was formed in 1919 as part of the Directorate of Hygiene, and replaces all former hygiene committees. In addition to military members representing the General Staff, Quartermaster-General, Master-General of Ordnance, and Director-General, Army Medical Service, Civil Public Health is represented on the Committee by three distinguished members.

The duties of this Committee embrace the following:—
Sanitary problems in connexion with barracks, huts, hospitals, water supplies and methods of purification; schemes for the disposal of waste water, refuse and excreta.

Technical questions as to disinfectors and disinfectants, food requirements of the soldier, clothing and equipment.

Organization and direction of research on matters affecting the health of the Army. Consideration of Parts I and II Hospital Services.

The function of the committee is in some respects similar to that of the Royal Commission of 1862 as it advises on all sites for new barracks or hospitals and type plans, especially in regard to sanitary requirements.

**Hygiene Organization in War.**

When an army takes the field in future there will be a complete hygiene organization based on the experience gained in the late war.

In forces of small size, assistant directors of hygiene and pathology will be appointed to the headquarters of the force, and as many deputy assistant directors of hygiene and pathology as are considered necessary.

A representative of the Directorate will also be appointed to the headquarters of a corps. Sanitary sections will be allotted to armies in the field in the proportion of one to each division and commanded by an R.A.M.C. officer specially trained in sanitation, but not necessarily a medical officer. Each section will have a fixed establishment of trained N.C.O.s and men including tradesmen, such as bricklayers, carpenters, and sign painters. The N.C.O.s are now termed serjeant or corporal sanitary inspectors.

For a force of one or more armies, a directorate of hygiene, similar to the peace establishment, will be required.

In addition to the above organization the hygiene directorate of an army in the field will be supplemented by mobile hygiene and bacteriological laboratories, and base hygiene laboratories. It is interesting to note that the first appearance of a laboratory in the field was in the South African War.

It is satisfactory to record that the health of the Army since the War has steadily improved and that at the present time the health statistics are only a little above pre-war figures. In this connexion, however, we must remember that we have not yet returned to full peace conditions and that until quite lately troops were still occupying several unhealthy areas in new territory acquired during the War.

The incidence of venereal disease and scabies in the Army at home has steadily declined since the war and this is due entirely to the hygienic preventive measures adopted in all commands.

The incidence of venereal disease in 1920 was 48·3 per 1,000 of strength and that of scabies 51·57.

At the present time the ratio per 1,000 for venereal disease is 25 and for scabies 8, and in each case is lower than that shown in pre-war returns.
The general mortality rate is now reduced to pre-war figures and there appears to be no reason why it should not further be reduced.

It is an interesting fact that minor injuries head the list of prevailing diseases in commands at home, followed by venereal disease, disease of the digestive system, inflammation of the bowels, and areolar tissues in that order. Venereal diseases, diseases of the digestive system and injuries, head the list for service at home and abroad.

Formerly, in all armies, even in peace, the mortality due to injuries and accidents was greater than in civil life. The mean of the four years 1859 to 1862 was sixty-one per 1,000. The mortality due to injuries in 1922 was 0·68, a little lower than in 1913.

In the years 1859 to 1862, it is interesting to note that the diseases in their order of fatality were tuberculosis, violent deaths, pneumonia, diseases of the heart, fevers (typhoid and typhus), diseases of the nervous system, bronchitis and delirium tremens.

The mortality from tuberculosis at that time for the whole Army was not in excess of the rate for the civil population, the rates being 3·8 and 3·6 respectively per 1,000 living. The incidence fell most heavily on the Foot Guards, however, and was computed to be nearly four times as much as among the civil population of from 25 to 45 years of age.

The great sanitary reforms of Lord Herbert and the Royal Sanitary Commission which were carried out in 1858, shortly after the Crimean War, led to an extraordinary decrease in the mortality of all arms, and especially in respect of tuberculosis.

The Royal Commission reported that 57·3 per cent of the deaths in the infantry of the line were caused by diseases of the respiratory organs, and of the deaths in the Guards no less than 67·6 per cent. The total rate of mortality per 1,000 per annum amounted to 176, which was nearly double that of the civil male population of army ages. They considered that the cause of these high rates of mortality could be assigned to:

(1) Night duty.
(2) Want of exercise and suitable employment.
(3) Intemperance and debauched habits among soldiers.
(4) Crowding and insufficient ventilation, and nuisances arising from latrines, and defective sewerage in barracks.

At the present time the admission rate for tuberculosis in the Army is 1·3, whereas up to 1862 it was somewhere about 3·6 per 1,000.

In regard to disabilities classified under disease of the heart which still are a frequent cause not only of rejection on enlistment but also of admission to hospital and invaliding, there is no doubt that much of the high incidence in the past was due, as pointed out by Dr. Maclean, then Professor of Military Medicine, to the mischievous restriction to which the chests of the soldiers were subjected at a time when the maximum of exertion was demanded. In 1866 at least fourteen per cent of discharges were due to heart disease.
Delirium tremens which in those days accounted for a mortality of one per cent has now practically disappeared from army medical returns. Probably never in its history has the Army been so temperate as it is at the present time, and to this alone can be attributed much of the improvement in health and physique which exists to-day.

I am not concerned at present to enlarge on this subject, but the question originally put by Edmund Parkes as to whether there are any circumstances in the life of the soldier in which the issue of spirits is advisable deserves some consideration. It does not appear to be generally known that alcohol forms no part of the soldier’s ration either in peace or war, nor to my mind is it really necessary except under exceptional circumstances, and then only on the advice of a medical officer. We all know that in the late war a ration of rum on occasions was beneficial in the exceptional circumstances of life in the trenches, when men were exposed day and night to inclement weather, fatigued beyond measure and exposed to constant and unremitting mental strain. Until we find a suitable substitute, a certain amount of alcohol in the shape of spirits seems to me to be beneficial as a nerve or gastric stimulant to men under circumstances such as these, but habitual use is not justified under any conditions of service.

Special Research.

Within the last few years there is one direction in which hygiene has made marked progress, and that is in what may be termed physiological and bio-chemical hygiene. From the study of this branch of hygiene, more and more, do we see what possibilities are opened up to us, and the bearing it has on the improvement in the life and welfare of men in the Service. The Army Hygiene Advisory Committee has paid great attention to the work of a soldier and has already issued several reports, which are of great practical value. Especially would I mention the work in 1917 of Professor Cathcart and Captain Orr, on the energy expenditure of the infantry recruit in training, undertaken to determine the food requirements for the performance of military duties. Beyond the two researches conducted in 1913 under the direction of Colonel Melville on the energy requirements of marching there had, up to this time, been no serious investigation of the food data, and the work of Professor Cathcart and Captain Orr fulfilled a much felt want. The result of their investigation has been to facilitate the construction of army diets under all conditions of military training and service.

The recent physiological observations and experience of Professor Cathcart and his co-workers, making use of the perfect methods of research of modern science, have successfully demonstrated that the economic load of the soldier should not exceed one-third of his body weight. This may be regarded not only as a close approximation to the truth but possibly will not be changed by further or better grounded work. It is true that
the economic load of the soldier has been recognized as a third of the body weight for many years, but it is due to Professor Cathcart that the limit of the economic load has now been decided by practical scientific observation, never achieved or attempted before. The practical outcome of this is, that the average soldier weighing 135 pounds should not be expected to carry more than forty-five pounds properly distributed, if his maximum fighting efficiency is to be assured. Although it is not expected that this standard can at present be attained, because modern warfare necessitates so much to be carried for protection alone, still it serves as an ideal standard around which to work and already the weight now carried is very greatly diminished from that which gradually accumulated in the past war. I would refer those of you who desire further particulars, to the Report No. 3 of the Army Hygiene Advisory Committee, published in the June, July and August Nos., 1923, of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.

Let me also mention the investigations of Captain A. G. Stevenson, of the R.A.M.C. and Captain R. L. Brown, Royal Engineers, on the motion study of digging and the energy expenditure involved. From a military, as well as a civil, point of view this question is of considerable importance and with the exception of one or two researches in shovelling by American workers, no serious investigation of digging had been undertaken with the object of increasing efficiency of output and economizing energy. During the late war skill in digging was thought to be of a poor type and was lacking in uniformity: accordingly, a digging drill, based on common-sense principles with due regard to the methods of skilled navvies, was introduced as part of the training of recruits in the Royal Engineers. It was thought that a complete scientific investigation of the whole problem, therefore, would still further increase efficiency in digging and as a result of this piece of research a new drill resting on a sound scientific basis is being introduced for both the Royal Engineers and the Infantry.

Mention should also be made of the series of analyses of the commoner foodstuffs by Professor Plimmer carried out during the war and completed under the Directorate of Hygiene and published in 1921.

During the late war, especially in the Army, an authoritative series of analyses was greatly required, since much of the data already in existence referred to food in other countries than our own.

Owing to the lack of a common standard, there was no uniformity in the energy value of rations constructed in the different theatres of war and the need of a standard series of the foodstuffs of our country was much felt. This most important and most valuable piece of work now forms the basis of a common standard of food values for all branches of His Majesty's Services.

Some interesting work has been carried out during the past year with a view to the determination of the food requirements of growing boys.

In order to obtain some standards for comparison, it was considered
that more information was necessary as to the growth and physical development of boys in military schools and boys in the general population, and the first results obtained made it clear that age alone could not be used as a basis. It could not, for instance, be assumed that taking seventy-five pounds as the average for a boy of 12 years, a boy of the same age weighing only seventy pounds was of inferior physique.

It became necessary, therefore, to establish the relationship between weight and stature, with a view to the utilization of the latter in lieu of age as the basis.

Here, there are variations between races and individuals, but Professor Dreyer in his book, "The Assessment of Physical Fitness," gives tables showing that a definite relation exists between trunk height and other desired data, irrespective of age.

Weight, again, has variations, which occur in a normal and healthy person as a result of the virtual impossibility of balancing input and output. A weekly variation of from three to four pounds is quite compatible with health, and seasonal variations are also recognized. There is also the physiological increase in weight which takes place after the age of 21. Notwithstanding these difficulties, it has been possible to construct a hypothetical table showing a definite and progressive increase in weight for each inch in height up to 21 years, and, on checking this table by reference to actual heights and weights of large numbers of recruits, the results were found to bear a close resemblance.

A further hypothetical table of calorie requirements for the average youth expending average energy was constructed by Lieutenant-Colonel Sylvester-Bradley on the basis of the formula \((H - 3)^2 = C\), when \(H =\) stature in inches, and \(C =\) total food requirements in large Calories.

From comparison with actual dietary tables as regards known units, the table appears to work out correctly. A diet of this value enables the boy of four feet in height to receive the 2,000 odd calories he requires, and the boy of five feet three inches 3,600; and, given the average height of the boys in an institution, the calorie requirements, and hence the dietary of any given number of boys can be worked out.

**Tonsillitis.**

Tonsillitis has always been prevalent in the Army, and shows an annual ratio of thirty-three per 1,000 at the present time. Up to now sufficient attention has not been paid to a disorder which, although generally mild in type, yet constitutes a distinct cause of inefficiency. It, undoubtedly, is a disease respiratory in transmission, and associated with overcrowding and neglect of efficient ventilation. This is borne out by the fact that troops in camps and under canvas even in winter rarely suffer from the disease, except under the conditions of overcrowding. During the winter of 1914-15 hutted accommodation was inadequate in many camps in this country and overcrowding became excessive. It is not surprising; there-
fore, that outbreaks of tonsillitis were very frequent and the type so severe that the disease was often prefixed with the name of the camp in which it originated, e.g., "Bulford sore throat." The disease is frequently met with in barracks in hot dry countries during the spring months, and is attributed by some military medical officers to dust. It is also of interest to note that the incidence of tonsillitis is far greater among troops in Egypt, Palestine, and India, than at home.

During the war in France tonsillitis was infrequent and certainly the incidence was low among men in the line. The disease appears to be more prevalent in old barracks, where overcrowding is apt to occur, and there has been a marked incidence among troops on board transports. Prior to the improvements in the accommodation on transports which have recently been sanctioned, the incidence of tonsillitis on board ship was 68.8 per 1,000, exactly double that in barracks at home and in foreign stations. In this connexion there appears to be some relationship between tonsillitis and minor septic diseases, both of which account for a relatively large number of admissions to hospital at home and abroad and on board ship, and the only remedy at present would appear to be greater attention to the allowance of space per man in barracks, aiming at a clear space of three feet or more between adjacent beds.

It is generally conceded that the spread of infectious disease affecting the respiratory tract is influenced in army life by a variety of circumstances of which overcrowding is probably one of the most important.

All epidemiological experience points to the very marked effect which overcrowding exerts upon the spread of disease. It is a matter of common knowledge that where diphtheria occurs among men who are crowded together, carriers of the Klebs-Löffler bacillus are unusually numerous and when these men are spread out in well-ventilated quarters the "carrier" condition rapidly disappears. The evil effects of crowding together in ill-ventilating wards patients suffering from measles or influenza are well-known. The severity of the disease increases, and deaths from pneumonia as a complication may reach a high figure. One recalls the high rate of mortality from pneumonia, which occurred in 1918 on the overcrowded transports carrying American troops. All experimental evidence supports the view that the distance between beds is of paramount importance, and that quite a moderate degree of spacing out of beds combined with simple methods for improving ventilation is highly effective in reducing carrier rates.

Proximity of heads and degree of ventilation are therefore the criteria by which the adequacy of accommodation in barracks, quarters and on board ship, should be judged. During the war and since, I have always emphasized the importance of considering wall space as a guide in the prevention of overcrowding.

In one of the commands, an attempt has been made to space out the beds in barracks so that the heads of the occupants are separated by an
interval of six feet, where the number to be accommodated, the shape of
the room and the position of the windows admit. The officer commanding
the unit notifies the officer in medical charge when closer spacing has to
be adopted, so that a close watch for evil effects arising from this cause
can be kept.

In regard to tonsillitis, the pathological directorate in association with
the hygiene directorate have instituted investigations to determine the
bacteriological flora of tonsillitis, and the bacteriological flora of the throats
of contacts in barrack rooms from which cases of sore throat are constantly
reported, to ascertain prevalence of carriers, and it is hoped some practical
solution in the way of prevention may result.

Sandfly Fever.

During the war sandfly fever was very prevalent in Egypt, Palestine,
Macedonia and Mesopotamia, and caused much sickness among the French
troops at Cape Hellas. In badly infected areas it was possible for fifty
per cent of the troops to develop the fever within a few weeks under field
conditions.

Since the war the disease has caused some anxiety, not only in
Mesopotamia, Egypt and Palestine, but also in India, Constantinople and
Malta, and recently in Jersey, and a great deal of scientific investigation
is being carried out as to the best means of prevention under all conditions
of the soldiers' service.

The most recent work on the subject has been contributed by the
Royal Air Force Sandfly Fever Commission, in Malta, who issued their
report in February, 1923, on the prophylactic measures directed against
phlebotomus. The measures suggested are divided into general, to be
carried out by the unit as a whole, and personal, to be carried out by the
individual. Among general measures are advised the levelling and drainage
of the ground, filling in of cracks and holes in walls, repair of windows
and doors, ventilators and rainwater gutters. Facing, painting and tarring
walls and the regular limewashing and painting of interiors. They
recommend, also, spraying huts and other buildings every week with a one
per cent solution of cresol. Among personal measures, bathing after dusk,
the wearing of slacks after sunset, and soiling of the ground must be pro-
hibited. The use of sandfly nets and repellents, such as camphor in beds,
with the utilization of natural air currents and a liberal supply of electric
fans, are considered essential.

In the Near East we found it necessary to issue sandfly nets for the
use of all troops, but have not placed any reliance on repellents. The
mention of mosquito nets brings us to a most important consideration,
and one in which we have now come to a definite conclusion, namely, the
standardization of mosquito netting for protection against mosquitoes and
sandflies.

A great deal of confusion existed in regard to the factors necessary to
determine the mesh and the method to be employed in its calculation. Measurements were based on so many holes to the linear inch, but it was not clear to anyone what this really meant or whether the measurement was to be taken along the warp or along the bobbin. These measurements also did not correspond with those used in the trade, and much confusion resulted. The measurements formerly recommended were as follows: A mesh of 12 holes to the linear inch against ordinary mosquitoes, of 16 to 18 against anopheles or stegomyia, and of 22 against sandflies.

Colonel MacArthur took the question up in January, 1923, and the result of his work has smoothed out our difficulties and placed the standardization of mesh for army use on a clear basis. His article on the subject appears in the January, 1923, number of the \textit{Journal of the Royal Army Medical Corps}. Measurements are now taken in two directions, horizontally along the warp and obliquely down the bobbin, the corner hole being counted twice; the thickness of the thread being taken also into consideration.

Colonel MacArthur considers that cotton netting of 25/26 holes to the square inch and woven 30/s or 40/60 cotton will exclude mosquitoes when used as a mosquito curtain under natural conditions. A finer mesh, however, is desirable for veils.

The standards now recommended for army use are the following:

<table>
<thead>
<tr>
<th>Netting Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosquito netting</td>
<td>28/29</td>
</tr>
<tr>
<td>Mosquito veil netting</td>
<td>40</td>
</tr>
<tr>
<td>Sandfly netting</td>
<td>48</td>
</tr>
</tbody>
</table>

\textit{Rations.}

Very shortly after the termination of the war, it became necessary to revise the rations of the soldier both for home and abroad, and also the scale of diets for patients in military hospitals. Naturally during the war the scale of rations had considerably increased above that required in peace and the return to a fixed peace scale was not only in the interest of the soldier but made for considerable saving in public expenditure. Prior to the war, the soldier received \( \frac{3}{4} \) pound of meat and one pound of bread supplied as a free ration and in addition a money allowance of 3d. per head was given to supplement the ration issued by the Government. Dr. Pembry calculated that this ration gave an energy value of 3,369 calories, while if the amount purchased by the soldier out of his own pocket was included each man might receive 4,000 calories per day.

A very great improvement of this ration has been made since the war and the soldier to-day receives an ample ration at Government expense. From a scientific point of view this is most desirable, since a standard ration makes it possible to study the relationship to energy expended during training and otherwise. The new rations both for home and abroad were carefully considered by the Army Hygiene Advisory Committee and a standard fixed, below which it would be unsafe to go.
Efficiency and economy had both to be considered and the ration as it stands to-day has proved to be entirely satisfactory.

The daily energy expenditure of the soldier at the present time amounts to somewhere about 3,380 calories and the ration for home service was based on this daily expenditure of energy. Other factors had also to be taken into consideration, such as food for growth, etc., so the energy value of the present ration is equivalent to 3,600 calories per diem; also it must be remembered that the soldier, no matter how good the ration, naturally supplements his ration by meals and otherwise out of his own pocket. It is surprising how much the young recruit patronizes the regimental institutes for additional food to satisfy his needs, and doubtless the growing lad should eat as much as he feels inclined, irrespective of all laid down principles. Variety is obtained in the ration by allowing a certain amount of commutation and daily menus are prepared by all units, based on a monthly menu issued by the supply branch of the Army. In addition, not only economy, but also greater variety and palatability has been effected by improvement in the cooking generally. During the earlier part of the war the cooking left much to be desired and much waste of food was attributable to this defect alone.

Regimental cooks are now most efficiently trained at the Army School of Administration and hospital cooks at Aldershot and the result has had a most important bearing on army efficiency.

Before commencing training as a cook, every man must be certified by a pathologist that he is not a carrier of enteric or dysentery germs, and in special cases this examination may be extended. This also applies to all men employed in the preparation of food and in both cases, men suffering from diarrhoea are ordered to report sick at once.

In preparing an army ration, one has to consider not only the energy value, but also its portability, its variety, its suitability to varying climatic conditions, its keeping properties and the kind of food men are accustomed to, among other matters. During the war in France scales of rations had to be considered for various races of mankind, but even so, the impression left on my mind was, that coloured races would readily take European food if it were offered to them, and that their diet, varying according to supply, depended largely on the necessity for consuming food that alone was available. From a long and careful study of the requirements of an army in the field in temperate climates, I am certain that the needs can best be met by a sufficiently varied diet having an energy of about 4,000 calories. Greater than this is wasteful, and less, is uneconomical also, since under stress of active service a man to be efficient in all respects must be well fed. In addition, the diet must contain a right amount of fat and a sufficient supply of fresh vegetables. In regard to the first, we should not go below seventy-five grammes of fat per man per day. There is no difficulty in this because, in a ration containing twelve to fifteen ounces of meat, there will always be an excess of fat. By good manage-
ment, suet may be utilized for puddings and dripping can replace butter to a great extent, but wastage is now prevented in the Army by saving all the waste fat, even that from the used plates, which is rendered and sold, the soldier partaking of the profit.

A sufficient supply of fresh vegetables is now insisted upon in all scales of rations and dried vegetables in lieu have been condemned.

It would here not be out of place to remark that all messing utensils used by the men after use are sterilized in boiling water, or in some cases in soap and water. The Army and Navy Canteens are bringing out a special apparatus to effect this conveniently. Table appointments have been improved and great care is exercised in the preparation and storage of food. Food safes are insisted upon for all units, and bearing in mind the danger of food poisoning, the preparation and partial cooking of food overnight and re-heating the next day before consumption is discouraged.

Hospital diets during the war were based on an allowance of each food constituent per 100 patients as originally devised by Sir Napier Burnett. This system was carried out most successfully up to quite lately when, owing chiefly to the reduction in the number of patients in each hospital a return to a fixed scale, to be regarded as a guide was made for economical reasons and convenience of working. The extras allowed, however, are considerably in excess of those before the war in spite of economy effected. With the present prices of food patients should be well fed for 2s. 7d. a day and officers for a little more.

Conclusions.

I have to some extent indicated the lines on which we have been working but much remains to be done, especially in regard to the prevention of disease among armies in the field and improvement in the general efficiency of the man as a fighting unit. During the past war many diseases hitherto unfamiliar in the field became convincingly evident, and although overcome or kept in abeyance they were nevertheless the cause of much wastage which, if only we had known, might have been prevented.

I need hardly remind you of the old saying, "In war it is the unexpected that happens." There are still problems of the late war left undetermined. Although the incidence of nephritis declined in the last year of the war we cannot say that we have satisfactorily arrived at the etiology of the disease or have laid down adequate measures of prevention. Undoubtedly the progress of science will show the way to prevent or lessen the incidence of many diseases, such as influenza, which caused more deaths in France in a few months than did all the rest of the infectious diseases during the whole course of the war; but it must be remembered that even well considered measures of prevention dictated by science may meet serious obstacles to their success under the difficult conditions of active service in the field. No war in the future will present just the
same conditions as in the past, and it is certain that new features will be introduced which may tax our energies and zeal in the same way as formerly. In preparing for war it is useful to visualize every disease and devise a plan of campaign for its prevention, which although not complete in every detail or exactly suited to the conditions which may arise still will offer a sound basis for attack, and any modification will be met more easily than if we had not considered it at all. The occurrence of trachoma and such diseases as nephritis and trench foot rather took us by surprise, and although the measures of prevention were in part known their application was entirely new and called for exceptional measures in difficult circumstances. The chief cause of wastage from disease in the last war may be attributed to venereal disease and uncleanliness. Both of these can be prevented, and we are endeavouring at the present time to devise measures which should prevent or lessen their occurrence in the future. In regard to uncleanliness I may mention that owing to the measures taken from the very first to prevent vermin and uncleanliness the troops lately in the Near East were kept entirely free and no wastage from this cause resulted. The conditions were not quite the same as if the troops were actually engaged in warfare, but even so there would have been little complaint.

At the present time, a War Office Committee is investigating the whole question of the prevention of vermin and uncleanliness in the field, and it is anticipated that our Army in the future will be provided with both efficient cleansing sections and mobile laundries in the field and on the lines of communication, and that wastage from this cause will be reduced to a minimum. Other nations are also considering this question from the practical side.

I suppose that the Navy and Army medical authorities of this country will always be hampered to a certain extent by public opinion in carrying out preventive inoculation against disease. In the late war our Army was the only one in which inoculation against typhoid or vaccination against smallpox was voluntary.

There is no question that protective inoculation opens up a great field for the protection of troops on active service, and following the success of inoculation against enteric it is probable that the best results will be obtained against dysentery, still a heavy scourge of armies in the field, by a similar vaccination, whereby much inefficiency will be prevented and many lives saved.

In a report on the dysentery epidemic in the department d'Ille-et-Vilaine in France, 1921, attention was drawn to the fact that of all prophylactic measures, a vaccine given either subcutaneously or by the mouth appeared to be the most efficacious.

As an argument against vaccination it has been contended that although a very large percentage of the British troops in France were not efficiently protected by vaccination yet they did not suffer from smallpox. The truth
of the matter is that the British Army was surrounded by an efficiently vaccinated population in the shape of the enemy in front and the Belgians and French alongside and was thus protected, otherwise the occurrence of smallpox would have been inevitable. In Mesopotamia, where no protective barrier existed, the incidence of smallpox among our troops, as is now well known, became a deadly menace. I have probably had as much experience of army sanitation in the field as anyone, and I am convinced that although efficient sanitation goes a long way in prevention, you cannot under the exceptional circumstances attending active service in the face of the enemy entirely prevent smallpox, or intestinal infectious disease by sanitation alone. There are certain zones of active operations where efficient sanitation is impossible and reliance will have to be placed on protective inoculation until some further advance in science renders this unnecessary.

I will not weary you further by enlarging on a subject which is of intense interest to us all, and I am conscious that I have not put the matter before you in as clear or as interesting a manner as I could have wished, but let us remember to our satisfaction that we, whether Civil, Naval or Army hygienists, are in the happy position of representing a service which in war gains victories not by the destruction of life, but by our efforts in saving life, and that no one appreciates our work more than the sailor, soldier or airman himself, which is the best return for any self-sacrifice we make, or feeling of disappointment we may have, in working for such a result.