A body of troops is a community in which, in addition to organization for combat, provision must be made for all the needs of a civilian community, for supply of food and water, for shelter and warmth, for refuse disposal, for personal cleanliness and laundry, for care of the sick, and for all the other innumerable details that arise where human beings live in crowded places. The military sanitarian has some advantages over his civilian colleague. He has his community under more-rigid control than the latter and the individuals comprising it are young and hardy. These, however, are his only advantages. To offset this, he is confronted with the difficulties that arise from the housing of many men in barracks, from the exposure and hard work that form the daily routine of their lives and, most important of all, from the fact that all his arrangements must be made with the clear recognition that there will be times when all considerations of health must become subordinate to the purposes for which his community has been formed, namely, the training for combat and battle.

In training areas and base sections, the problems of military sanitation are very similar to those of civilian work. In the case of an army occupying a front line sector, the conditions are modified by the many factors which active warfare involves. It is these latter problems that we wish to consider more particularly.

The organization of divisions is based upon the necessity for mobility. A division is a spear which must be thrust and withdrawn as military needs indicate. It must be complete in itself and carry within its organization the elements of all the parts necessary for independent functioning. Often
The Sanitation of a Field Army

A gain in mobility involves an inevitable loss of efficiency, and the sanitary organization of divisions therefore must necessarily do without many of the arrangements that are possible only in a permanently organized territory with extensive laboratory facilities, bathing and disinfection apparatus and all the other devices which are perfectly arranged only when more or less permanent occupation of an area is possible.

Divisions are gathered in corps, and the corps occupies an area. But as warfare was developing just before the armistice was signed, the corps was a tactical unit and its headquarters were changing almost as frequently as divisional changing stations. Consequently corps areas were shifting to meet the rapidly changing necessities of strategy.

It is in the Field Army only in which we can, for the present, count upon the occupation of an area for a reasonably definite period; long enough, at least, to justify the undertaking of extensive organization and construction, with relation to territory occupied, and it is only in the army organization, in which we can formulate a system of sanitation based on area, which can so reinforce the divisional organizations as to fill in the defects existing in the latter by reason of their greater mobility.

An army sanitary organization, under conditions of warfare such as those which, until recently, prevailed in France, should be so constructed that it combines careful sanitary scrutiny and control, with sufficient mobility to adapt itself to advances, to the shifting of flanks, contractions and expansions of the occupied territory.

When the British armies first entered the battlefields of Flanders, they had sanitary squads or detachments attached to divisions just as we had them in the old tables of organization. It soon developed that an army area is a section throughout which a continuous shifting and rearrangement of the composing element must take place. Divisions move forward into the line, remain in position for varying periods and are withdrawn for replacements and rest. Other divisions move forward from reserve positions to take their places. Artillery changes its emplacements. Supply and ammunition trains, engineering detachments and labour troops move about whenever needed.

Within the more or less constant limits of the army area a continuous circulation of units takes place, a shifting of troops to and fro, an active wandering about like that of ants in a hill. It is apparent that there is much wasted energy and loss of efficiency if every division is required to organize its sanitary arrangements de novo whenever it is moved. The knowledge gained and the work done by one division is lost to the one that moves into its place, and a new investigation of water sources, billets, dumps, latrines, baths and everything bearing upon the control of disease becomes necessary whenever divisions change locations. It has been found, in consequence, that some form of constant central supervision by the Army itself will remove these obvious defects. This is the principle which underlies the British army sanitary organization, and it is this
system, in its essentials, that we have found worthy of emulation. We have borrowed from the British system certain essential elements but have attempted to adapt these to the more mobile conditions which prevailed on all parts of the front during the latter months of the war. The following outline describes briefly the plan instituted in the 2nd Field Army, A.E.F., with the official approval of the commanding General. The plan is similar in most of its details to that conceived and carried out for the supervision of the advance section, A.E.F.s, by the chief surgeon of that section, but differs from this in the attempts made to remain prepared for sudden extension forward of the army area, and the rapid organization of conquered territory.

Outline of Plan for Area Sanitation, 2nd Army.

The army area is divided into administrative sub-divisions to be known as sanitary sections. The area as at present constituted will be divided into three such sanitary sections, and in the future expansion or change in the territory occupied by the 2nd Army can be easily adapted to corresponding changes in the sub-divisions. In a central point in each sanitary section there will be stationed one commissioned officer, lieutenant or captain, Medical or Sanitary Corps, chosen for his training in practical sanitary methods. Each sanitary section will be again sub-divided into eight to twelve sub-areas. These will be so outlined as to be small enough to be patrolled on foot, thus obviating the necessity for additional transportation. Into each sub-area will be placed two or three enlisted men and non-commissioned officers chosen for their general intelligence and training in sanitary inspection. Further training will be given these men by the commissioned officer commanding the squad in each sanitary section. It seems likely that a number of sanitary squads so selected can at the present time be obtained from personnel or divisional sanitary squads now assigned to the S.O.S.

Duties.

I.—Duties of the commissioned officer in charge of squad. The commissioned officer assigned to each area will:

1. Maintain in the town of his station a sanitary school for the instruction of non-commissioned officers and enlisted men of sanitary squads, and a shop for the construction of sanitary appliances, such as latrine seats, etc.

2. He will select and distribute men of his squad to the eight to twelve sub-areas in the section. He will direct and advise the work of the men in the sub-areas by receiving reports and keeping in constant touch with them, by circulating in his area.

3. He will keep in touch with all matters of sanitary importance in his section and furnish all such information to zone majors, medical officers and commanding officers of all units that enter the area.
(4) He will keep in constant touch with corps and division surgeons in his area, furnishing them all information at his disposal.

(5) He will be directly responsible to the chief surgeon of the 2nd Army through his sanitary inspector, reporting all matters that in his opinion need correction.

Duties of Sanitary Squads.

II.—Sanitary squads will be divided into groups of about fifteen to twenty men, who will work at the station of the squad commander, in the shop and in the sanitary school. The remainder will be assigned in groups of two or three in each of the small sub-areas. The place in each sub-area at which they are stationed will be so chosen that from it they can patrol the entire area on foot. These men under the direction of a commissioned officer will:—

(1) Keep detail maps of the sub-area, showing everything of sanitary importance, water sources, latrines, urinals; stables, cesspools, dumps, baths, lavoirs, kitchens, billets, barracks, camps, etc.

(2) They will inspect and keep in repair permanent sanitary appliances located in their sub-areas, such as latrine seats, baths, kitchens, etc., drawing upon the sanitary shop of the section for labour and materials.

(3) They will keep in touch with the engineer water personnel working in the sub-area.

(4) They will, as well as possible, keep themselves informed of infectious diseases occurring in the civilian population in the sub-area and see that such disease is promptly reported to the proper medical authorities.

(5) They will furnish all information gathered by them to town majors and commanding officers of incoming troops as soon as they enter the area.

(6) They will report all sanitary defects which require attention to squad commanders of section.

(7) They will plan improvements of permanent sanitary installations and confer with the squad commander regarding them.

(8) They will report upon the condition of sub-area or parts of it whenever troops leave this area.

(9) They will exercise no administrative or other authority, their functions being those of inspection.

(10) Their maps will be kept up-to-date and copies furnished incoming troops and others whose health depends upon such knowledge.

(11) It should be understood that the enlisted men of sanitary squads are not labour troops, i.e., they do not police or care for grounds, billets, and areas, or dispose of refuse. They function as assistants to the sanitary inspector of the 2nd Army.

These arrangements provide an adequate sanitary supervision, which serves the important purposes of keeping constant guard over the area occupied by the army, facilitating the tasks of incoming troops, obviating the necessity of frequent and useless repetition of sanitary surveys of the same territory and keeping the army authorities constantly informed.
of prevailing conditions and needs! By constant co-operation with billeting majors and with officers and men of the water service of the engineering department; moreover, these squads form a co-ordinating link which serves to convey necessary information from one service to the other.

When the army area changes by advance or lateral shifting it is a relatively easy matter for the squad commander, whose area is adjacent to the newly acquired territory to extend his work into this. If complete change in the location of the army takes place, the squad commanders concentrate their men at a central point, move them forward and after a rapid survey on their motor cycles, in consultation with the billeting officers of G. I, redistribute personnel. Such a shift should not require more than three or four days at the most, and as a matter of fact, when the system has once been thoroughly established and the personnel trained, the survey of a new area can be carried out with increasingly greater speed.

When the army is engaged in active combat it is best to exclude from the above scheme of organization a strip of territory about four kilometers deep, immediately behind the trench lines. This area is subjected to shell-fire and any kind of constructive activity of a permanent nature is rendered difficult. In this area it is best to leave sanitary work entirely to the divisional authorities, in direct consultation with the army sanitary inspector, who should keep in close personal touch with the divisions in the line.

Relations of the Army Sanitary Office to the Sanitary Inspectors of Divisions.

The army sanitary organization should not interfere in the slightest with the sanitary organization of the several divisions in the army. The routine sanitary supervision of divisional troops in all matter pertaining to health should be left as hitherto, in the hands of division surgeons and division sanitary inspectors. It is the duty of the army sanitary inspector however, and all the machinery at his disposal, to reinforce the divisional facilities, to advise the responsible divisional officers and to place at their disposal the experience and knowledge he may have gathered by reason of his intimate acquaintance with the area. The army sanitary inspector should be a man, not only trained in field sanitation but one who by experience in laboratory and epidemiological work can reinforce the divisional facilities whenever infectious disease of any kind occurs. Whenever infectious disease is reported from divisions in more than isolated, unrelated cases, the army sanitary inspector should confer with the divisional sanitary inspector; examine the prevailing conditions and advise. It is he, who, either in person, or through trained assistants, should make epidemiological studies and laboratory studies whenever these seem indicated for the purpose of arresting the spread of contagion. He should be the adviser of the chief surgeon of the army in matters of sanitary policy, in circularization of information, and in the meeting of any emergency. It is his duty to
organize the area supervision and the transmission of information concerning the areas to incoming divisions. It is his function to establish and maintain liaison between the divisional authorities and other services of the Army which have bearing on sanitary problems, such as the water service of the engineer department and the bathing and disinfection activities of the quartermaster department.

To carry out these functions, he must have, first, transportation; second, assistants and personnel for area organization; third, a system of report whereby he can keep records of the daily occurrences of communicable disease in all units of the army. His functions, thus defined, do not in any sense curtail the authority or diminish the responsibilities of the divisional medical authorities.

The question of the proper personnel of the army sanitary organization will be tabulated below.

Reports.—It is necessary for the sanitary inspector of an army to keep constantly informed concerning the prevalence of communicable diseases in all troops of the army, both those in divisions and those designated as army troops. For this purpose he must maintain in his office some kind of a reporting system whereby he can constantly keep his hand on the pulse of the sick rate. In working out a system of reporting for active army organizations it should always be borne in mind that unit commanders and medical officers are often over-burdened with paper work, and that the multiplication of such duties may interfere seriously with their more important function, namely, the actual execution of the duties they are asked to report upon. For this reason, whenever outlining a system of report one should scrutinize each report demanded as to whether it is actually one which will furnish information on a basis of which action can be taken. Provision is already made in Army Regulations for routine reports of many kinds, and the routine information which is really needed is constantly passing through the proper sources automatically. What the army sanitary inspector needs to know is whether contagious diseases are occurring, when and where, and in which company units.

The company unit is important because it indicates occurrence in groups which are eating and living together, and therefore this report gives information as to contact. Knowledge of the place where the disease occurs is very important when troops are stationary, less important when they are constantly moving about in an army area. But nevertheless even here the place is of value since the occurrence of a considerable number of cases in one and the same place within a limited period may point to faulty condition of barracks, billets or water-supply. The system which has been worked out and is in use in the 2nd Army is simple and gives the necessary information.

Paragraph 12, Manual of Sick and Wounded Reports, A.E.F., September 15, 1918, provides that special daily telegraphic reports of admitted communicable diseases must be sent to the Chief Surgeon, A.E.F., by all
field, evacuation, camp and base hospitals. Report must give name, rank, company and place of origin of infection whenever possible. For the purposes of the individual Field Army it is sufficient to require duplicate telegrams from all the field and evacuation hospitals in the army and to request similar duplication of telegrams from any base hospitals that are situated so close to the army area that they may receive patients direct from army units without their passing through field and evacuation hospitals. On receipt of these telegrams, an assistant in the office of the sanitary inspector takes them each morning to the statistical office of the army; checks the location of the units from which the diseases were reported, and then lists them and records the information in the following manner:

(a) Record of Units.—A book is kept in which separate pages are so lined that cases of epidemic diseases can be entered by date and company, one page being given to each unit in which the disease occurs. An example of such a page is shown on p. 330. The letters in the squares representing the code adopted for the brief designation of different diseases.

(b) Spot-map.—A wall map of the entire army area is kept, and when an infectious disease occurs a pin is stuck into the location from which the disease is reported, pins with a variety of coloured heads used for different diseases. Each pin is thrust through a little square of paper on which is written the date and the unit. When the area is one of an army actively engaged in combat, in which units are moving to and fro with great rapidity, the knowledge of the place from which the case is reported loses value by virtue of the fact that the disease was probably not contracted in the place from which the report comes, and from the fact that by the time the patient has been in hospital two or three days this unit may have moved to another location. However, the spot-map can nevertheless be made of value by the following procedure. At the end of each week the information found on the spot-map is entered in a book. In this way there is constructed a record of all places in which infectious diseases have occurred during the week. When this information has been entered in the book for the past week the pins are taken out and replaced with common pins (without coloured heads), which are left to form accumulated evidence of all infectious diseases that have occurred in each place. When a large number of such pins accumulate in any single space, it is simple, by going back to the book in which the diseases are kept by places, to find out which particular variety of disease has occurred there. Beginning with the new week, the coloured pins are again entered as before. The map, thus, at all times, shows not only the nature and location of the disease occurring within the week, but also indicates, by a massing of the common pins whether or not these places have been frequent sources of disease. After a while it is of value to study the movements of units in which infectious diseases have occurred and draw lines, across the maps with red or blue pencil along the paths of movements followed by these
The Sanitation of a Field Army

No. 170-54. Office of the Chief Surgeon, 2nd Army.

November 1918

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>HQ</th>
<th>MCH</th>
<th>SUP</th>
<th>SAN</th>
<th>GUN</th>
<th>COM</th>
<th>DET</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>Band</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ORGANIZATION 56 Infantry

November 10 at Bouillonville. November 19 at St. Marie Farm.

Sanitary Inspector's File of Epidemic Diseases by Organization:


The station entered at bottom of each sheet is corrected daily from the revised list of the Statistical Office.
units. This can easily be done by reference to the information in the "unit" and "place" record, and it may occasionally be found that lines drawn for infected units may intersect at places at which a considerable number of infectious diseases have occurred. By putting in dates it may sometimes be discovered that a unit which has reported communicable disease has passed through places from which similar cases were removed from other units, within periods representing incubation times.

As implied in the above, a further record, arranged by places, is kept in an ordinary ledger in such a way that there is a page for every town in which a communicable disease has occurred, and all cases reported from these towns are entered on this page.

To summarize, we then have a cross-indexing of records as follows:

1. Record by units from which contact studies can be made.
2. Map record of places, as described above.
3. A ledger in which the occurrence of disease is recorded by place of occurrence.
4. A week-book in which weekly records of the map are preserved after the renewal of pins.

In addition to these records, constant contact should be kept with divisional surgeons and sanitary inspectors and medical officers of army troops who are requested to communicate directly with the sanitary inspector of the army when they wish advice on any sanitary matters, or when any of the units under their care show the occurrence of infectious disease which they regard as warranting remedial action. Such an arrangement, especially if the sanitary inspector has the confidence of the officers involved, forms an indispensable check on the records described above, and makes it possible also to keep in touch with the occurrence of diseases which it is unwise to designate as "reportable." Such, for instance, would be influenza. When a few isolated cases of so-called influenza occur, they have very little sanitary importance, and reporting them would needlessly encumber the paper work. When influenza occurs as an epidemic, the cases are usually so numerous that telegraphic reports are not feasible. In this disease and a few others, therefore, we must rely on the direct information by contact with the officers in charge, with whose co-operation intensive study of the situation must be made when epidemic conditions prevail.

The activities of an army sanitary department are, in other words, analogous to those of the combat branches. A routine of reliable information must be established on the basis of which the needs of ordinary times can be attended to, but this organization must be sufficiently elastic and possess sufficient reserve margin to detect promptly and to be capable of reacting by special efforts to emergencies or sudden changes that may occur.
Laboratory and Epidemiological Service.

Just as the laboratory is of partial efficiency only in hospitals if the bacteriologist is unfamiliar with the cases in the wards, so in armies the laboratory service cannot be entirely efficient unless the laboratory officer is trained in, and in touch with, the epidemiological data. For this reason the sanitary inspector of the Army, who should be capable of acting as an adviser to medical officers and sanitary inspectors of the several troop units, should be a man not only trained in practical sanitation but one who at the same time is familiar with the facts of epidemiology, the methods of making epidemiological surveys, and can handle a laboratory for the control of communicable diseases as an important tool of his profession.

The laboratory organization of a Field Army when the army is holding a definite sector should consist of a stationary mobile laboratory within reasonable proximity to army headquarters. This main army laboratory should be equipped for all cultural work, and have a personnel consisting of at least two or three commissioned officers and five enlisted men, three of whom are trained technicians. Attached to this army laboratory there should be one to two mobile laboratory cars equipped as are those now in the A.E.F. or those designed by the British for army use. When the army is moving, as in a rapid advance, or is changing its areas for other reasons, the two mobile laboratories may suffice. Each mobile laboratory should have as personnel, one bacteriologist, one driver and one trained technician. There should be with it a motor cycle which can be used for the collection of specimens and for epidemiological studies. The stationary army laboratory should also be a supply laboratory for the mobile laboratories which proceed from it as a base on special trips.

It is doubtful, at the present time, whether the divisional laboratories as formerly organized and equipped should be continued. When divisions are reasonably stationary, such laboratories can be of great value for the performance of clinical pathological work for field hospitals, and can materially aid in the speed and detection of communicable disease, more particularly meningitis, diphtheria, amebic dysentery, malaria and tuberculosis. It should never be attempted to equip such a laboratory for extensive laboratory work, for when divisions are moving or actually engaged in combat insuperable transportation difficulties invariably arise. Moreover, under such circumstances, patients who are sick for more than a few days are evacuated to hospitals where laboratory facilities are available, and the largest epidemiological problems can best be handled under any circumstances by the mobile army laboratories described above. The bacteriologist in charge of these cars can be trained by the army sanitary inspector to make epidemiological studies and thus utilized can independently attend to the rapid contact and carrier studies which should be made in direct co-ordination with the actual laboratory work. It is our belief that a thorough laboratory training is essential to work in epidemiology.
divisional laboratory man should be utilized in the same way as special assistant to the divisional sanitary inspector.

In discussing laboratory work in field armies it should always be borne in mind that an army engaged in combat or holding a sector is not the place for research. The laboratory should be an instrument in the hands of sanitary authorities for the prompt detection and arrest of communicable diseases. For these reasons it is of great importance that we should consider briefly the extent of laboratory work which it is wise to carry out in active field armies.

The most practical solution of the clinical pathological problems for divisions would seem to me to maintain a number of such organizations for assignment to divisions when circumstances are such that the laboratory can functionate to advantage. These laboratory units organized as at present could remain under the control of the Director of Laboratories of the army and assigned to divisions for indefinite temporary duty when the respective divisions are at rest, assigned at the request of the division surgeon, and withdrawn and reassigned wherever needed when the particular division is in combat or moving.

It goes without saying that mobile laboratories and all purely diagnostic laboratories which are connected with an army organization should at all times be carefully supervised in order that the promptness of diagnosis which gives the clue to epidemiological investigation and control shall be efficiently carried out.

One of the fundamental principles underlying successful epidemiological laboratory work is to restrict it to the amount which can be accurately done. We are entirely out of sympathy with the extensive carrier examinations which were instituted in the camps of the United States for the control of meningitis upon the occurrence of a single case. Our own observations have not given us the impression that this work has had much effect upon the reduction of the disease incidence and we are absolutely sure that the technical inaccuracies inevitable in such wholesale bacteriology largely defeat the purpose of the work.

It is in our opinion more important to restrict the laboratory work at first to rapid and accurate diagnosis, and to abstain from extensive carrier work until a number of cases have occurred in one and the same unit. The principles of prevention of most of the diseases of importance for army sanitary control are fairly well understood, and after the discovery of a single case in a unit it is more important as a rule to concentrate speedily upon the correction of general sanitary defects for the control of the particular disease. Most all of the important military epidemics are either of respiratory, digestive, or of insect transmission.

For sanitary purposes we consider as respiratory in mode transmission:—

Pneumonia, influenza, measles, scarlet fever, meningitis, diphtheria, mumps, chicken-pox.

Diseases transmitted by the digestive route are:—
Typhoid and paratyphoid fever, the dysenteries, simple diarrhoeas.

It is not possible to generalize intelligently when speaking of different diseases. For this reason, the principle of epidemiological and laboratory procedure which we believe sound and effective can best be presented by submitting in more or less detail our reasoning and actual methods of work for each disease in question. Some considerations leading to our method of handling meningitis will be pertinent as illustrating our point of view.

Epidemiologic records show that almost universally in very few instances is one case of meningitis directly referable to a preceding one, as is the case in measles, small-pox, etc. Almost universally divisions that have meningitis show a scattered distribution, there being often as many individuals, or almost as many, involved as there are units, and when the cases are so plentiful that several or many occur in the same company or platoon, it is almost exceptional (though obviously it must occasionally occur) that direct connexion between one case and a preceding one can be established. This shows with great definiteness that in the transmission of meningitis the carrier is of comparatively greater importance than the case.

It also shows that the disease is one to which the susceptibility of individuals varies within very wide margins, otherwise we would frequently find, as in typhoid fever and other diseases, groups of cases radiating back to the same carrier source. This, however, is not the case and it is this that I mean when I say that here is a phenomenon, where the incidence of meningitis is more a susceptibility than a transmission problem.

It will be well for purposes of practical army sanitation to classify disease according to susceptibility phenomena. There are some diseases like typhoid, typhus, small-pox, plague, cholera, measles, scarlatina, and some others to which susceptibility is universal and all individuals who have not had these diseases or have not been artificially protected are likely to contract them if exposed to a sufficient dose of the virus, that is, to a minimum infectious dose. There are other diseases, like pneumonia, in which the normal human being, well-fed, well-dressed and not otherwise diseased is highly resistant and will withstand without harm exposures that will infect promptly his fellows less cared for, or for other reasons in poor physical condition. In the former class the sanitary measures must always primarily consist in contact prevention by the discovery and removal of cases and carriers combined with the supervision of intermediate means of transmission and specific vaccination. In the latter group of diseases the contact matter must of course also be kept in mind, but the primary point of attack must be the general hygienic measures that aim at the prevention of resistance—lowering conditions. In the case of meningitis we are dealing with a disease in which normal resistance is probably high in most individuals. There exist, however, a group of individuals who for reasons not hitherto clear are abnormally susceptible, this susceptibility being a permanent, perhaps congenital property with them, diminishing
with adolescence in some of them, remaining with others, increasing with all of them when general physical environment is poor. That such diseases as influenza predispose to meningitis is probable, as recent experiences seem to indicate. The supposition that there are individuals who are normally susceptible to meningitis is based on facts observed by all who have dealt with this disease. In all epidemics there are many individuals who are in perfect health and remarkably good physical condition, who develop the disease and die rapidly, while others may harbour meningococci in nose, throat, and even lungs, but escape meningitis. Whether or not such relative immunity depends upon an acquired resistance, whether it is measurable by serum or skin reaction, these are interesting fields for investigation, but too little is known at the present time concerning this to allow us to discuss it.

The carrier problem in meningitis, moreover, differs from that in typhoid fever and some other diseases in important respects. A typhoid carrier is apt to be a chronic carrier. In meningitis it is apparent from the excellent studies of the British and some of our own that carrier rates, in one and the same troop unit, fluctuate between very wide limits. During the warm months, when meningitis incidence is low, the carrier rate is correspondingly low. During the autumn and winter months, coincident with the spread of catarrhal conditions of the upper respiratory passages, the carrier rates go up even to twenty per cent and above.

In the face of these simple facts let us consider how meningitis epidemics come about, why they occur, and in which respect the occurrence of such epidemics differs from those of such diseases as measles, typhoid fever, etc., and other diseases to which all previously uninfected individuals are susceptible.

In any command at any given time there is a definite percentage of susceptibles and there are a number of carriers, varying according to the prevalence of upper respiratory catarrh and degree of crowding of the command. When the command is first organized a few cases of meningitis occur if chance brings these two groups into close association with one another. Sooner or later the command settles down to a more or less regular routine of reciprocal contact between definite groups of individuals associated in fixed platoons and companies, billet or barrack companies. It is summer and there is little catarrhal disease. Men do not spread saliva by sneezing and coughing, and if occasionally they do, the relatively healthy mucous membranes of the recipients do not form a favourable nidus for a flora of organisms so delicately vulnerable to symbiotic conditions as the meningococcus. Cold weather, exposure, etc., come on. Carriers acquire colds and begin to secrete and spread mucus; their meningococci become more plentiful on the diseased mucosa, and are brought down from the upper places in the nasal sinuses; the men begin to crowd together about stoves and sleeping quarters. Other men similarly diseased become carriers. The carrier rate goes
up and with it the mathematical chances of contact between susceptibles and carriers increase at more than geometrical ratio. Moreover, more men become susceptible because of influenzal or other infections of the nose, throat and bronchi.

With these facts as a basis, how should we handle meningitis in military units? It seems to me utterly useless to attempt to take out all carriers by examining bacteriologically entire regiments or divisions, as has been attempted in the past.

The following circular illustrates the procedure as adopted in the 2nd Army, A.E.F., for the management of meningitis, as based on the preceding considerations.

The following measures should be taken when meningitis occurs in the command:

1. When one case of meningitis appears in a unit, make a thorough sanitary inspection of the unit, and enforce with great strictness the existing regulations concerning space between beds, ventilation, and mess-kit washing. Nothing else need be done.

2. When two or more cases occur within the same ten days or two weeks, in addition to the above, have all men inspected at least once a day, and remove all those with severe colds and coughs from sleeping quarters, screening them from each other with shelter-halves hung between beds, if necessary screening off the part of the barrack in which they are put from the rest of it, preferably putting them together in a separate building. Treat coughs and colds as things requiring the attention of the medical officer, as though they were really dangerous sources of infection to others. Other matters of inspection such as cleanliness of floors, spitting, etc., go without saying.

3. When two or more cases occur in quick succession in such a way that one can reasonably become apprehensive of an incipient epidemic, the following measures should be adopted:

Carry out strictly all the provisions incorporated in the preceding paragraphs, regard the command as probably badly infected, and take great pains to separate out the coughs and colds. Do your utmost to find facilities for additional quarters, and spread the men out in small groups, or allow as much more space as possible beyond the minimum required. If necessary, put some of the men under tentage or in pup-tents, giving them extra allowances of covering. The argument that this cannot be done in the whole A.E.F. is invalid, because this command is to be managed as an infected one. Have a non-commissioned officer supervise mess-kit washing in boiling water. Inspect quarters during the day as often as seems necessary according to discipline of the command, and, at least, once during the night for ventilation. Notify the office of Chief Surgeon, 2nd Army immediately, so that army laboratory may undertake to do carrier rate examinations on the command. Preventive measures beyond those stated above will depend upon the result of laboratory examinations.
The following Sanitary Order, 2nd Army, A.E.F., will illustrate our opinions as to the proper balance to be struck between the employment of general sanitary measures and laboratory investigations in the actual control of epidemics in an active field army. The section on meningitis incorporated in the original is omitted to avoid repetition.

**Regulations for the Control of Communicable Diseases, 2nd Army, American E.F.**

The following circular is issued for the guidance of medical officers of the 2nd Army in their most important function—that of preventing communicable disease.

The sense in which the word "quarantine" and "contact" are used is first defined in order to avoid ambiguity.

**Definition of Quarantine.**—It is impossible to lay down iron-clad rules applicable to all conditions. A certain amount of discretion must be left to the medical officer in charge. In making recommendations, both military necessity and medical expediency must be considered. Military duties and training must be interfered with as little as possible. In making recommendations, it is advisable to put them in such form that they may be issued directly as an order.

**Definition of Contacts.**—The following will be considered contacts:

1. Men in same tent; 2. men in the same room in billet; 3. men in same barracks who have been sleeping within three-bed distance on either side of patient within the last ten days; 4. those men who have been in particularly intimate association with a case during the probable infective period.

Definition of quarantine. Quarantine may be of two degrees: (1) absolute; (2) partial or working quarantine.

1. Absolute quarantine. Men are strictly confined to a definite area, and all association of any kind with others is forbidden. This is only applied in very serious diseases, such as small-pox, typhus fever, plague, etc., or where the extent and degree of the epidemic warrant strenuous efforts for its control. A guard is usually necessary.

2. Partial or working quarantine. Troops are allowed to attend out-door formations. It is preferable that they be drilled or worked separately, but when this interferes with military training, it need not be insisted upon. When off duty, they are to be kept absolutely separate from others, messing alone, or at a different hour, and washing their mess-kits in separate boiling water. It is the type of quarantine usually employed.

(1) General Procedure.

(i) Measures to be taken immediately when respiratory disease occurs. In this category are included pneumonia, influenza, measles, scarlet fever, meningitis, diphtheria, and mumps:

(1) Quarters.—Inspect quarters to determine overcrowding. The ideal
to be aimed at is a minimum floor space of four by ten feet per bed. Under no circumstances ever allow less than twenty square feet, and, if this seems impossible of attainment, report immediately to higher sanitary authority (Bulletin 94, H.A.E.F., 1918). Make sure that all the available space in your billeting area is in use, and that there are no unoccupied rooms or barracks while others are overcrowded. When the space allowed is less than four by ten feet, hang up shelter-halves between beds by stretching strings from wall to wall. Under all circumstances enforce head to foot sleeping. When double-deck bunks are provided, try to allow five feet between individual bunk units. Separate the two men sleeping on the same tier by shelter-half partitions. Be sure that men across aisles are sleeping head to foot. Not more than fifty men should go into an Adrian barrack. During warm weather shelter tents should be used in preference to crowded barracks. Ventilation must be strictly enforced, and inspections made at least once between taps and reveille to enforce the keeping open of windows. Blankets and bedding will be aired for several hours on dry days. Spitting in quarters will be made subject to disciplinary action. Floors of sleeping quarters will be swept after sprinkling with water once a day.

(2) Mess-kits.—Mess-kits must be washed in boiling water. The mess-kit water should be kept on the fire and kept full of soapsuds. Rinse in running water. Do not dry on a common towel. When no fuel is available it is better for the men to wash individually in running water, wiping out with paper or leaves, than to wash in the common lukewarm can of diluted saliva.

(3) Inspect men twice a day, once at roll-call, once at retreat. Look them over for colds in the head, red conjunctivæ, coughs. Ask a few pertinent questions. Take temperatures of men who are not feeling well or who have severe colds. Segregate those with colds and coughs by putting them into separate sleeping quarters. If no such quarters are available separate a part of one barrack or large billet by making a partition of suspended blankets. Hospitalize all the cases with temperature.

(4) Investigate equipment of men with especial attention directed, to supply of overcoats, raincoats, serviceable shoes, three blankets per man and three pairs of socks.

(ii) Measures to be taken when intestinal disease appears—typhoid, paratyphoid, dysentery, or epidemic simple diarrhea.

(1) Inspect latrines. See that they are not too full; that the seats and covers are tight and that there is no trickling where bottom of box fits on the ground. When materials are available have latrines burnt out once a day. Fill up all that are too full and have new ones dug not less than five feet deep. If no lumber is available for covered latrines see that there is a pile of dirt and a shovel on hand and either inspect frequently or put a guard on the latrines to make sure that the men cover every defecation and soiled paper with dirt. If available, wash woodwork once a day with a solution of cresol, a pint in two buckets of water, and sprinkle residue of
this on feces. Sprinkle inside of latrine once daily with chloride of lime, if available. If epidemic conditions prevail have wash basin and soap handy and force every man to wash his hands after defecation. Supply no towels. Hands should be allowed to dry in the air.

(2) Inspect kitchens and enforce cleanliness in the handling and preservation of food. See that meat is protected from flies. Stop the use of salad, fruit, milk or other uncooked food. Enforce the washing of hands of kitchen personnel before the handling of food. In permanent camps, kitchens must be screened. Inspect kitchen personnel and remove those who have intestinal symptoms.

(3) Attend to water supply. Personally assure yourself of proper chlorination of water and the cleaning of carts if water-carts are used. Request bacteriological analysis of sources from which the water is taken after chlorination. If necessary put guards on public water supplies, faucets, etc., and instruct men concerning the dangers of unauthorized sources.

(4) See that garbage, offal, the dead bodies of horses, etc., are promptly buried to reduce fly-breeding. Have manure piles removed, covered or packed tightly.

(iii) Notify commanding officer of organization of existence of an incipient epidemic.

(II) Special Procedures.

Sanitary Management of Meningitis.—The following measures should be taken when meningitis occurs in the command:

(1) When one case of meningitis appears in a unit, make a thorough sanitary inspection of the unit and enforce with great strictness the existing regulations concerning space between beds, ventilation and mosquito kit washing. Nothing else need be done.

(2) When two or more cases occur within the same ten days or two weeks, in addition to the above have all men inspected at least once a day and remove all those with severe colds and coughs from sleeping quarters, screening them from each other with shelter-halves hung between beds, if necessary screening off the part of the barracks in which they are put from the rest of it, preferably putting them together in a separate building. Treat coughs and colds as things requiring the attention of the medical officer as though they were really dangerous sources of infection to others. Other matters of inspection, such a cleanliness of floors, spitting, etc., go without saying.

Diphtheria.—On occurrence of a case of diphtheria, contacts will be put under working quarantine and a request made on the chief surgeon of the army for cultural examinations and Shick tests on the contacts and on the kitchen personnel of the unit in which the case has appeared. Carriers will be isolated and re-cultured after a week. Extent of cultural examination beyond this will be determined by the sanitary inspector.
The Sanitation of a Field Army

after an epidemiological survey. The entire command will be inspected at least once a day for sore throats. Positive Shicks will be given 1,000 units of diphtheria antitoxin. The administration of diphtheria antitoxin, with dates, should be entered on the Service record.

General measures given above, concerning quarters, mess-kits, etc., will be carried out.

Measles.—In addition to the general measures advised above, all contacts will be isolated in working quarantine for two weeks. The most important measure in the limitation of measles is the inspection of men at least twice a day, the prompt segregation of all men with colds or inflamed conjunctvae and the prompt hospitalization, as suspects, of all men showing temperature of 99.5 or above, by mouth.

Scarlet Fever.—In addition to general measures a working quarantine of all contacts for two weeks. Inspection as in measles. Especial attention to sore throats and temperature and segregation of those with severe “colds.”

Liberty Measles.—As in measles.

Mumps.—Working quarantine of all contacts for three weeks. Daily inspection with especial attention to swelling of parotids and submaxillary regions, and inquiry as to sore throats. Temperatures taken on all suspicious cases and men with temperature hospitalized.

Small-pox.—Absolute quarantine of entire unit. Revaccination of entire unit. At least two negative trials must be made. Daily inspection as above and release from quarantine two weeks after completion of re-vaccination.

Typhoid and Paratyphoid Fever.—(1) Inspection of the command from which the case has come, especially in regard to the water supply, latrines, kitchen and sources of food, etc., as listed above.

(2) Scrutiny of the vaccination records of the entire unit.

(3) Carrier investigation of the kitchen personnel requested.

(4) Attention to fly protection and breeding.

Nothing further will be done beyond the correction of sanitary defects unless a second case occurs in the same unit. When another case occurs in the same unit, repetition of the carrier examination on the kitchen personnel will be made and the entire unit re-vaccinated, with one dose of triple lipo-vaccine.

Dysentery.—Same procedure as in typhoid fever with particular attention to fly-breeding, latrines and the protection of food. Kitchen personnel cultured for the carrier state.

Amoebic Dysentery.—Same as above, with particular attention to the discovery of carriers. This problem should be referred to the Army Laboratory through the chief surgeon.

Trench Fever and Typhus Fever.—Cases that suggest these diseases should be immediately reported even if diagnosis is doubtful and measures taken to have entire command deloused immediately. If there is difficulty
in doing this, the problem should be reported to the chief surgeon of the army. If there is a case suspicious of typhus fever the entire command should be put under strict quarantine until satisfactory delousing has been accomplished, and several careful inspections for lousiness have been negative at intervals of one week. Typhus suspects should be evacuated in a separate ambulance; the cases marked as suspicious of the disease and all blankets, clothing, etc., on the patient or in the ambulance must be deloused.

Influenza and Pneumonia.—Principles of prevention. The principles of prevention consist in: Supplying of men with sufficient clothing and covering at night and keeping them as dry as possible. Each man should have three blankets, one suit of heavy underwear, three pairs of socks, two pairs of shoes, one raincoat, one shelter-half, and sweater. The avoidance of crowding in quarters and billets, and the provision of ventilation, as per "General Procedures." Care in the washing of mess tins in boiling water after meals. The prompt exclusion of men with colds in the head from common sleeping quarters and the delayed removal from companies of men showing the first signs of the definite disease. The evacuation of those sick cases separately from wounded and from those with other diseases. Proper care and segregation in hospitals. The first is a quartermaster's problem; the others are medical problems. All are disciplinary problems. Co-operation is, therefore, necessary and with it suppression of the disease is possible. These matters must be supervised by systematic inspection.

Dryness.—A wet man invariably is cold, and a cold man is susceptible to infection. Three or four tin stoves in a dug-out or a small hut make an excellent drying-room. Strings and nails in them make it possible for men to hang up their extra clothes to dry. They can then go to bed with dry things or have dry clothes to put on in the morning. A drying-room per platoon or company can easily be arranged with a little ingenuity and is of great sanitary importance, to say nothing of comfort.

Work.—When influenza is spreading rapidly in a command it is wise to remember that when men are overworked to the point of exhaustion they are rendered extremely susceptible to infectious disease. It is advisable, therefore, if military conditions at all permit, to ask that the drill schedule and other work be slightly reduced until the epidemic is under control.

Inspection and Segregation.—When cases of grippe have begun to appear the medical officer should attend roll-call and rapidly inspect all the men every morning. This can be done with speed by walking down the line, observing men for signs of "colds in the head," coughing, sneezing, or red eyes, and asking a few questions. Suspicious men should be made to step out and sent to the sick call, where temperature should be taken. Men with definite colds in the head, without temperature, should be taken out of their billets and made to sleep in special barracks or billets, or other
available space, with shelter-halves hung up so as to form screens between neighbouring beds. If possible, they should be given an extra allowance of bed covering. They should be placed on light duty for a day or two. If no special quarters are available for such men, put them all together at one end of the barrack and separate this end from the rest of the barrack by hanging up blankets or in some other way making a screen. Where the military situation will permit cases of influenza may be hospitalized in the divisional area. The attack is shortened and complications prevented by early bed treatment. Ample floor space must be allowed and screening between beds attended to. Gauze masks should be worn by patients and attendants when coming into intimate contact, especially during transfer and evacuation. Cases whose temperature continues for more than forty-eight hours or with signs of pneumonia developing, should be evacuated except from such hospitals as have been designated by the chief surgeon, 2nd Army, as respiratory disease hospitals. On all men showing temperature on first inspection careful chest examination should be made. If any signs pointing to extensive bronchitis or actual pulmonary involvement are found, the patients should be promptly evacuated.

Evacuation.—During evacuation, grippe cases should not be placed in the same ambulance with wounded or with other sick. Remember that in evacuating pneumonia, the greatest care must be taken to prevent their exeriting themselves. Do not let them walk or dress or undress themselves. Keep them on their backs. Failure to observe this may make the difference between recovery and death.

Hospitalization.—In evacuation and other hospitals, grippe cases must be placed in separate wards. Cases developing pneumonia must be taken out of the grippe wards promptly and placed in separate pneumonia wards. Beds must be screened one from the other. Attendants must wear light gauze masks. Sputum must be disinfected or burned. Thermometers must be sterilized.

The Water Service.

The supervision of the drinking water within the army area falls naturally into a number of phases. There is in the first place the necessity for the prompt discovery of water sources, estimation of probable output of each available source, with a rough sanitary survey of surroundings as indicating the probable degree of pollution. The larger water sources must be located at which it may be useful to establish automatic chlorine sterilization apparatus for the establishment of cart-filling points; provision must be made perhaps for piping of such water supplies. Finally, there must be strict supervision of the quality of water obtained from these sources. The arrangements at the present time authorized for the supervision of water supplies in armies are as follows:—

There is attached to each Field Army a body of engineer troops who are especially assigned to the water service. These troops maintain an
office at army headquarters from which they send out parties of trained engineers and attached sanitary officers to survey as rapidly as possible the entire army area. They rapidly follow up the advancing troops and in the experience of the past summer we have found that this service has functioned very satisfactorily and with promptness and willingness to cooperate with the medical department. The engineers have furnished maps of water points in the areas and by means of this sanitary personnel and attached laboratories have made bacteriological and other examinations of water supplies and have installed Wallace-Tierman chlorination apparatus both mobile and stationary, at all points where permanent chlorination plants seem to be warranted. It has been possible to transmit this information to divisional sanitary inspectors when divisions moved into new areas, thus relieving them of the necessity of going over the entire ground themselves. This has furnished an important basis for the control of water supply.

Analysis of any water source is of no practical value unless frequently and periodically repeated. For this reason, after the preliminary survey had been made and gross pollution discovered by bacteriological analysis this will be of value in indicating whether or not such a source should be completely excluded, but it is not practical to attempt to control the water supply by periodical laboratory analysis. It is best to assume that all water except that in which the engineering service has established permanent chlorination apparatus is polluted and must be chlorinated in Lyster bags or water carts. This must be supervised by a sanitary officer attached to the staff of each division surgeon, whose sole function it is to attend to the divisional water supply. It is the duty of this office to familiarize himself without delay with the records of the water engineers, to mark the locations of water points and engineer installations in his divisional area, to instruct divisional units in the proper use of the hypochlorite of calcium tubes, and Lyster bags and water-carts, and to circulate constantly among the divisional troops, correcting, supervising and enforcing those measures. It is not feasible to furnish such an officer with a laboratory equipment for laboratory analyses, this being both impractical and unnecessary, as indicated above, but he can with profit employ iodide and zinc sulphate solution for the control of proper chlorination, and can teach unit medical officers, mess serjeants and others in the division this method of control. Mess officers also should investigate from time to time whether all divisional units are properly supplied with Lyster bags and whether they are having difficulty in procuring a sufficient supply of calcium hypochlorite tubes.

It is the duty of the army sanitary inspector to keep in his office a complete record of the work of the water engineers on a map furnished by them and constantly kept up-to-date, to see that this information is transmitted to the divisional sanitary inspectors and the medical officers of army units, and to assure himself from time to time that Lyster bags and hypo-
chlorite solution are available and are being used. This he must do by
confering with divisional water officers.

During active combat it often occurs that advancing detachments have
no Lyster bags and therefore have difficulty in following our instructions
concerning water. When this occurs a number of different make-shifts
can be employed; and the army sanitary inspector at such times should be
in constant touch with divisional water officers to help facilitate their
problems by instruction and advice. By a simple calculation, assuming
that one gramme of hypochlorite of calcium gives about three parts per
million of available chlorine for forty gallons of water and that this gives
a sufficient margin for a successful sterilization, within half an hour of
anything except highly polluted and iron-containing waters, the fractional
addition can be made to containers of any size such as G.I. cans or any-
thing available. When a small detachment is dug in in isolated positions
or is moving in such a way that the men are dependent on canteens, the
following method can be used: the platoon leader or sergeant can place
the contents of a hypochlorite of calcium tube in his canteen and fill
this with water. If the hypochlorite of calcium is available only in bulk
he can fill the shell of a 45-calibre revolver cartridge with the powder
(a volume which represents about one gramme), place this in his canteen
and fill it with water. After thoroughly mixing, one teaspoonful of this
solution can be put into the canteen of each man. When the canteen is
filled with water from any reasonable source it can be assumed that within
twenty to thirty minutes the water has been properly sterilized.

Although poison examinations of water have not been found necessary
at the present time, it is nevertheless important that some provision be
made for the prompt detection of such contamination, when troops are
advancing over conquered territory. It is therefore desirable to have one
of the standard poison examination chests which are splendid for the gross
detection of alkaloids and poisons, in the hands of the divisional sanitary
officer, since he is the only trained man who is in touch with the advancing
troops. To have these chests in the hands of the water engineers or the
corps of army personnel is almost useless.

One of the difficulties encountered in the routine chlorination of water
is the occasional failure by lack of foresight or imperfect co-ordination with
the quartermaster's department, of units to obtain the needed supply of
calcium hypochlorite. It would be best to issue these tubes with the rations.
The division should have on hand 7,000 tubes per week; three tubes
being issued with every 100 rations. This calculation is based on the
allowance of four quarts of water per man per day.

BATHING AND DELousing.

It is not our intention to go into details concerning the actual methods
of bathing and delousing employed. These must necessarily differ according
to the place where troops are stationed, the numbers to be taken care of and the means available. The question of bathing and delousing is a quartermaster problem, and probably must to a great extent remain in the hands of the quartermaster because of the large amount of property involved. The co-ordination of the quartermaster's department and the medical department in regard to this work has been a difficult problem in the past but can be overcome, as it is being overcome in the 2nd Army by two important arrangements: One of these is to make bathing and delousing an army rather than a divisional function, the other to have in the office of the chief quartermaster an officer who is assigned purely to this and to laundry arrangements. This officer should be trained in the details of delousing procedures and the organization of bathing, delousing and laundry units. He should have a complete record at all times of all the delousing and bathing facilities possessed by the army and have experience in estimating the supplies needed for delousing plants of various sizes and constructions. The sanitary department of the chief surgeon's office advises him as to needs and locations, and helps him in the choice of sites, water sources and general organization.

The most easily organized and foolproof unit for these purposes are those constructed on the basis of a Foden-Thresh steam sterilizer and a converted Adrian barrack. These plants can be rapidly set up whenever an Adrian barrack and a suitable water source is available. They are partially movable and can therefore promptly follow up an advance or adjust themselves to other shifting of territory. Two such plants should be available for every division unless equivalents in the form of other types permanently placed are available. In addition to this every battalion should have a separate bath of at least one LeBlanc eight-shower head unit. Men should be bathed at least once every two weeks and a careful inspection for lice made at every bi-monthly physical inspection. Delousing should be practised as a routine at least once a month when divisions are in the line. When lice are discovered the lousy men should be immediately disinfested, and if possible under the tactical conditions prevailing, the whole company unit should be run through as soon as lice are discovered. This procedure is of vastly greater importance during the cold weather of the fall and winter when trench fever and typhus are apt to prevail and spread most easily. When cases of those diseases appear immediate energetic steps to delouse the command must be taken. This is perhaps one of the most important duties a sanitary inspector can attend to and upon his prompt action under such circumstances may depend the success of military operations.

It is our opinion that frequent inspection for lousiness is a duty the importance of which is not sufficiently emphasized. The early discovery of lice in a command is as important as the early diagnosis is of a communicable disease and at ordinary times, when men are living under reasonably clean conditions lousiness does not spread with great speed.
Early discovery will, therefore, simplify the whole problem. In carrying out the inspection the pubic and axillary hair and the seams of underclothing should be carefully scrutinized and the sanitary inspectors must make sure that medical officers are familiar with the appearance of nits. Too often these inspections are made in perfunctory manner.

**POLICING OF BATTLEFIELDS.**

Under certain conditions of combat, especially during rapid advances of large bodies of troops, the policing of a battlefield becomes a sanitary problem of considerable importance. This is the case more especially in hot weather when the dead bodies of men and animals rapidly become foci for the breeding of myriads of flies, which infest kitchens and mess tents and carry infection from the faeces almost inevitably accumulated in open trenches and in woods where troops have camped for brief periods in the intervals of active fighting. Under such circumstances diarrhoea and dysentery become epidemic and any defects in vaccination in bodies of troops become noticeable by scattered cases of typhoid and paratyphoid fever. It is even possible, indeed we believe that we have some evidence to warrant the assertion, that many cases of mild fevers with intestinal symptoms occurring at such times represent mild attacks of the typhoid and paratyphoid group of disease which are atypical because of vaccination. Our own experience during the Château Thierry offensive, as well as the previous observations of the British and the French, have demonstrated the great importance of the sanitation of the battlefield which in its neglect invariably leads to conditions that may seriously impair man power at a time when it is most needed.

To expect troops themselves to live up to the regulations regarding latrines and refuse disposal during the activities of a battle is not feasible, as experience has shown. It is equally impractical to expect them to police the camps they have occupied perhaps for a single night. The hurrying of their own dead not only takes away trained men from the fighting units but has a pernicious effect upon the moral at a time when this factor should be carefully nursed. This problem was approached, in the 1st Army Corps, and later in the 2nd Army, by organizing companies of Pioneer troops, either corps or army units for the purpose outlined above. A company is attached to each division in the line. On the night preceding the offensive each company is marched to a position behind the respective divisional line and reports to the sanitary inspector of the division. The liaison and preliminary arrangements are attended to by the army sanitary inspector. These troops then follow in the wake of the advancing infantry, attending to the work above indicated. By dividing them into squads spread across the width of the divisional front, the entire advance can be policed even when the country is thickly wooded as in the Argonne.
The following extract from a 2nd Army order illustrates the system in sufficient detail:

"(1) Memorandum No. 8, these Headquarters, October 26, 1918, emphasizes several provisions concerning the burial of the dead, which are covered by General Orders Nos. 10, 30, 50, 89, 106, and 122, and Bulletin No. 41, G. H. Q., A.E.F., 1918.

"In order to carry out these provisions and to facilitate the prompt burial of those killed in action, the following arrangements will be made in your corps:

"(1) The administrative order pertaining to the field order will direct that one company of Pioneer Infantry or equivalent, with the necessary picks, shovels, ropes, teams and wagons, will be assigned to each combat division. The commanding officer of this company will report this organization in due season to the division sanitary inspector, under whose direction the dead men and animals will be buried.

"(2) Three chaplains from each division will be detailed for temporary duty with this pioneer company. In addition to their religious duties they will act as burial officers, and secure the effects of the dead and dispose of them in compliance with existing orders.

"(3) In addition to the duties outlined above, the pioneer company will be used to police the temporary camps of rapidly advancing troops.

"(4) Upon cessation of an action, and after the duties directed have been performed, the sanitary inspector will request orders returning the pioneer companies to their proper stations.

"(5) These arrangements for the burial of the dead will be enforced only during and immediately after an action. At all other times the burial of the dead will not be a function of the sanitary service."

Respiratory Infection and Evacuation.

During action, especially under circumstances like those which prevailed in the Argonne where many of the men in the line were exposed to wet and cold for long periods, and developed grippe, a problem of evacuation of considerable sanitary importance arises. Efforts must be made to evacuate such respiratory cases separately from the wounded, and especially from the gassed. In both instances, more particularly in the latter, the respiratory cases may transmit to the latter streptococci and pneumococci which may determine the death of the patient. In one division of the 2nd Army it was recently found possible to mask all respiratory cases which came out of the line and keep them masked until admission to hospital.

Reserve Areas of Army when in the Line.

When divisions have been engaged in active combat during which their casualties may have amounted to several thousands, and are then taken
The Sanitation of a Field Army

out of the line to an army area for replacements and reserve, their sanitary conditions are apt to sink to a low level if left to their own devices. Men who have lived under combat conditions, who have gone through the harassing weeks of peril and exertion, are physically worn out and mentally strained. They invariably, when withdrawn from the line, relax, both mentally and physically, and it seems poor economy to expect them immediately to take up the routine of camp life and to begin their rest period by cleaning up and policing their new area, digging latrines and in other ways establishing the sanitation of their camps and billeting area. It has happened in the past that such divisions had to be stationed in areas that had been recently abandoned by divisions that have gone forward to take their places, and the consequence was that insanitary conditions with dangers especially great for men in their condition prevailed for a week or ten days, that is, until the division had been brought back to a more or less normal physical and mental state.

It is advisable for the sanitary inspector of the army to make the preparations and the supervision of reserve army areas a part of his activity, to keep in touch with the movements of troops in and out of these areas, and to endeavour with the aid of his sanitary squads to assist in preparing them for the reception of troops coming out of the line. The troops thus finding the areas in good condition are relieved for the first week (which is a difficult one for them) from extensive sanitary policing, and can take up this work themselves by the end of that time.

Problem of Replacement Divisions.

One of the important sources of the admission of infectious disease to divisions of an active army is the replacement division. A replacement division is usually located somewhere in the reserve area of an army, and through it pass a large number of casual troops, which after some training and perhaps re-classification and equipment are sent out to divisions in groups varying from a fraction of a platoon to a platoon and larger units to divisions that require replacements. The division, therefore, represents the small end of a funnel through which all kinds of contacts of communicable disease pass from the S.O.S. into the army. Also troops that are held for some time in the replacement camp may there be exposed to disease which may subsequently be scattered by them to many different units throughout the army area.

The replacement division, therefore, is one of the focal points which should have the especial attention of the army sanitary inspector. This division should establish a reception camp in which new arrivals are held until their medical examination can be made before they are turned into the main camp. The sanitary inspector of the replacement division should have special sanitary squads at his own disposal and the laboratory of a replacement division should be more extensive, both in equipment
and personnel, than that of the mobile divisions. Cultural work of all kinds should be possible.

When cases of infectious disease occur in a replacement division, prompt epidemiological surveys should be made and measures taken to prevent contacts from being sent to other divisions until the expiration of the incubation time. When cases of infectious diseases occur in the army itself an endeavour should always be made to find out whether the patient or his contacts have been recently added to a unit from the replacement division. If this way it may often be found that the origin of the disease is in the replacement division and that the point of approach for sanitary measures lies in that division rather than in the unit in which the case developed. The sanitary inspector of the army should keep in constant and immediate touch with the office of the chief surgeon of this division.

**Alterations in Sanitary Organizations when an Army goes into Rest Area.**

When an army is taken out of the line, divisions are usually placed in separate rest areas, which remain definite divisional areas for a more or less prolonged period. These divisional areas may not be in direct contact with each other, there being considerable stretches of unoccupied territory between them. In such a case, the area scheme above described is not feasible unless the personnel of the sanitary inspector of the army be vastly increased. It is best under these circumstances to have the trained army sanitary squads make preliminary surveys of the areas to be occupied by the divisions and to turn over to the divisional sanitary
inspector all information, together with recommendations and advice concerning the establishment of latrines, baths, delousers and other locations, and estimates concerning the amount of construction work to be done. After the division becomes established it will be best to station the available army sanitary personnel at various points from which the divisional areas are accessible and to limit their functions to those of inspecting and advising. The commissioned officers of the army sanitary squads should periodically cover a definite area, should be prepared to assign some of their trained personnel to the service of division, corps or army troops in instructing them in the construction of baths, latrines, incinerators, etc.; they should be on call for special rapid epidemiological surveys for infectious disease as reported from any of the divisions. In this way the chief responsibility of the sanitation of divisional areas remains—as it should—with the divisional authorities, who, however, benefit from the reinforcements by trained army personnel, and from the assistance of men experienced in epidemiological work and the handling of acute outbreaks of disease.

Should there be a Corps Sanitary Inspector?

The sanitary inspector of an army corps can be of great usefulness especially when, as frequently happens, the corps operates as a more or less independent unit. Since, however, the corps is almost entirely a tactical unit, with frequent shifts of location, and with divisions attached-
to the corps changing repeatedly, as strategy demands, it is best to have the corps sanitary inspector purely an advisory and inspectorial officer, who is particularly engaged in the supervision of the sanitation of the corps troops and forms a liaison of information between the divisional sanitary inspectors and the sanitary inspector of the army.

**Divisional Sanitary Squads.**

It seems essential that divisions in the army should retain their sanitary squads, as organized in the past. These two squads of twenty-six men each, under the command of two commissioned officers, should become divisional troops and remain so, whether the army is in action or in rest. They will not in any way interfere with any of the plans described in the above outline; they are so few in number that they represent no important additional encumbrance to transportation nor do they detract or abstract men from the fighting units to any important degree. They are, however, a unit which can be trained and can render highly proficient work in the instruction for sanitary construction and can thus add considerably to the safety of the troops.

The preceding schematic representation summarizes the army sanitary organization.