A STUDY ON THE PREVENTION OF INFLUENZA.

By Colonel G. Dansey-Browning, C.B.E.

One of the many problems which a medical officer in charge of troops has to face is how to decrease the number of cases of influenza and of feverish colds, which, year in year out, interfere with the military training of the soldiers under his care.

He recalls with horror the coughing, sneezing crowd which throngs the medical inspection room during the winter months, and realizes that the real problem of influenza has not yet been solved.

Unfortunately, the textbook methods of prevention, however carefully carried out, are on the whole unsatisfactory. The infection is elusive. It slips through the most carefully thought-out defences, and unlike many other diseases, one attack confers but slight immunity.

In spite of all the work that has been done on influenza, in spite of the wealth of literature and the recently published epidemiological records, the latest investigations leave us with no definite information regarding the actual specific organism concerned.

The foregoing statement is to be found in the Special Influenza number of the Practitioner, published in February, 1919, and is as true to-day as when it was written.

In spite of this unsatisfactory position, there is a tendency to mark time; to await guidance on the subject of prevention from further laboratory work. I submit that this is a mistake. The person who should be fully acquainted with gaps and potential sources of weakness in the lines of defence against influenza of any particular unit, is the medical officer concerned. By careful observation at the time he can often ascertain the special channels through which individuals become infected, and thus add materially to his knowledge of how to check its spread.

Observations of this nature will fall within the wide meaning of the term "medical research" used by the late Sir William Leishman to cover any means by which we, of set purpose and on a deliberate plan, strive to add to existing knowledge of the cause, prevention or treatment of disease.

The plan which I advocate has nothing original in the actual means of prevention employed, which consist in the usual routine precautions against direct or indirect transmission of the infection, in endeavours to raise immunity and to decrease the number of potential disease-carriers. In addition to these precautions, a carefully thought-out scheme of record is required, in which all essential factors concerning individuals attacked by the disease are carefully noted at the time that they are observed. It should be similar in form to the table of differences and resemblances used for noting down facts concerning individuals amongst whom an outbreak
of food poisoning has occurred. One such pro forma will be required for each unit under observation.

It will serve a double purpose. It will enable the medical officer to see at a glance where a gap in his defences has occurred when a soldier is attacked with the disease. It will also enable him to tabulate his observations so that at the end of the epidemic they may be compared with similar observations on other units elsewhere.

If it be decided to include in the plan prophylactic inoculation, it should be noted that a remarkable feature in the history of influenza is the change of opinion which has recently taken place regarding the prophylactic value of vaccines. In 1919 their value was generally appreciated both in this country and in America; Rosenau, Wynn and others strongly advocated their use.

Leishman gave the following figures from the Army Medical records of 59,144 men:

<table>
<thead>
<tr>
<th></th>
<th>Number observed</th>
<th>Influenza per mille</th>
<th>Pneumonia per mille</th>
<th>Deaths per mille</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inoculated</td>
<td>15,624</td>
<td>14-1</td>
<td>1-6</td>
<td>0-12</td>
</tr>
<tr>
<td>Non-inoculated</td>
<td>43,520</td>
<td>47-3</td>
<td>13-3</td>
<td>2-25</td>
</tr>
</tbody>
</table>

Hogarty, writing from Canada in February, 1919, stated that the only hope for prevention of influenza lay in the use of vaccines. W. H. Wynn was of opinion that 1,000 million B. influenza might confer immunity lasting several months, while that from 30,000,000 probably lasted only a few days. Recently published work has not confirmed these opinions; observations carried out in the winter of 1928—1929, on troops in the Aldershot and Southern Commands failed to demonstrate any beneficial results from the use of anticatarrhal vaccines. To what causes should this change of opinion be attributed? Is it due to changes in the composition, mode of sterilization, administration or dosage of the vaccines now employed?

It was known in 1919 that Pfeiffer's influenza bacillus was not the primary organism which caused the disease, although it played an important part in the production of the symptoms. Pneumococci and streptococci were considered chiefly responsible for the gravity of the secondary pulmonary complications. The primary infection was thought to be due to a filter-passing virus, and this view was confirmed by the findings of Nicoll and Lebaillly.

It was agreed that the vaccine should be polyvalent and contain Pfeiffer's bacillus, pneumococci and streptococci in various proportions, to these Pneumococcus haemolyticus and M. catarrhalis were subsequently added, and the vaccine became known as anticatarrhal vaccine. The War Office Conference recommended that it should be sterilized at 55° C., and contain 0·5 per cent phenol for preservative purposes. The first dose consisted of B. pfeiffer 80 millions, pneumococci 100 millions, and streptococci 40 millions. The second dose was double that of the first.
In order to avoid a negative phase there was an interval of ten days between the doses. The content of *B. pfeiffer* in this vaccine was subsequently found to be too little and it was increased.

Rosenau pointed out the necessity of using strains of organisms recently isolated, and giving them in adequate dosage.

Major N. T. Whitehead has kindly furnished me with notes on the composition of the anticitarrh vaccine now issued by the R.A.M. College, of which the following is an extract:

- (a) *B. pfeiffer*, 400 million per cubic centimetre, from strains isolated in 1920 and 1923.
- (b) *Streptococcus hemolyticus*, 30 million per cubic centimetre from National Collection of Type Cultures (1928).
- (c) *Streptococcus non-hemolyticus*, 30 million per cubic centimetre, from National Collection of Type Cultures (1928).
- (d) *Pneumococcus*, Type I, 80 million per cubic centimetre (1928).
- (e) *Pneumococcus*, Type II, 80 million per cubic centimetre (1928).
- (f) *M. catarrhalis*, 30 million per cubic centimetre (1921 and 1925).
- (g) *B. coryza*, 30 million (1922, 1923 and 1924).
- (h) *B. friedländer*, 50 million (1925).

All these organisms are killed at 60°C, except *B. friedländer*, which is killed with phenol 0.5 per cent.

The vaccine, as issued, contains 0.5 per cent phenol as a preservative.

None of these vaccines contains antigen to the primary virus of influenza, but only antigen to the secondary catarrhal, streptococcal or pneumococcal infections to which the clinical importance of the disease is chiefly due. The success achieved in immunization against canine distemper by recent intensive work at Mill Hill, leads one to hope that, by analogous methods, an antigen to the virus of influenza may, before long, be obtained. In the meantime, the composition of the secondary vaccines should be reviewed andendeavour made, by using more recently isolated strains and seeking improved methods of preparation, to provide antigens which will give results comparable to those recorded in 1918 and 1919.

A possible explanation of the discredit into which prophylactic inoculation for influenza has fallen of recent years is that statistics do not clearly show what dosage or vaccine has been employed. An observer in the Aldershot Command, who recently made a careful analysis of the results of prophylactic inoculation with mixed cold vaccine of 9,000 men, was unable with the data at his disposal to place in separate categories men who received one dose, two doses, or two courses of the vaccine. This difficulty would not have been met with if details of the inoculation had been entered up at the time in the appropriate pages of the Soldiers' Pocket-book, A.B. 64, which is carried on the person.

Another fallacy is the tendency to class together the results of vaccine therapy on tonsillitis and on influenza sore throat, two distinct clinical entities which occur at different seasons of the year.
A Study on the Prevention of Influenza

In Army practice, inoculation is not compulsory. The medical officer who wishes to give this method a fair trial has to rely on personal persuasion, opportunity and tact. Special inoculation parades are of little value, as few volunteers attend. A good method is to offer prophylactic inoculation to all men who report for medical inspection on rejoining the unit on return from courses or from leave. Volunteers can then be called for from men who have not left the station, and many will attend. The matter should be explained in the annual lectures on sanitation and, when opportunity occurs, in informal talks.

Observations at Longmoor.

Longmoor is a huddled camp in the Aldershot Command. Its garrison is composed of one Medium Brigade of the Royal Artillery and a Railway Training Centre of the Royal Engineers. The strength of troops varies from 600 to 807 men, with 27 officers, 58 women and 89 children living in the camp. The huts are of wood or of galvanized iron. The walls are double and lined with felt. The roofs are of galvanized iron and the floors are above ground-level. They were built in 1907 and have been kept in good repair. Their size conforms with the War Office scale. There is a minimum floor space per bed of 60 square feet, with adequate height. The average number of occupants per hut is 19. There is at least 6 feet of wall space and a 3-feet interval for each bed. Twenty-seven of the families are housed in brick buildings; the remainder are in huts. These buildings and huts are partitioned off into A, B or C types of married quarter in accordance with the authorized War Office scale.

Throughout the year precautions against influenza and droplet infection are in force. They are based on Command Orders, an extract of which is given in Appendix I of this article. Gargling, as a preventive measure, is also carried out by the troops daily, under supervision, during the winter months. During the winter of 1930-31 there was an epidemic of influenza in the Aldershot Command. Although a number of troops were attacked, the mortality was inconsiderable.

In Longmoor, where there was a mild epidemic in January, February and March, I set myself the task of finding out by observation the answers to the following questions:

1. The relative incidence of influenza amongst single men living in huts with beds properly spaced as compared with that amongst the occupants of married quarters.

2. The incidence of the disease as influenced by the use of drinking and eating implements sterilized by hot water after preliminary cleansing.

3. The effects of inoculation with mixed cold vaccine on the severity of the disease.

In formulating these questions I was aware that the number of data I could collect at Longmoor would be insufficient, owing to the small size of the garrison. I thought, however, that the Longmoor figures, if carefully

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Tabulated and correlated with similar observations made elsewhere, might be of value in drawing up future plans for the prevention of the disease.

**Effect of Spacing Beds.**

The incidence of influenza at Longmoor amongst 525 men housed in huts with properly spaced beds during the months of January, February and March, 1931, was 17 as compared with a case incidence of 39 amongst 205 occupants of married quarters during the same period. Double beds were provided for the families, on the scale of 1 double bed per room. The number of men, women and children who were attacked is shown in the following table:

<table>
<thead>
<tr>
<th>Occupants</th>
<th>Number</th>
<th>Cases of Influenza</th>
<th>Ratio per mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single men's huts</td>
<td>525</td>
<td>17</td>
<td>32.38</td>
</tr>
<tr>
<td>Married quarters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>58</td>
<td>8</td>
<td>137.9</td>
</tr>
<tr>
<td>Women and children</td>
<td>147</td>
<td>31</td>
<td>210.9</td>
</tr>
<tr>
<td>Total—Married quarters</td>
<td>205</td>
<td>39</td>
<td>190.2</td>
</tr>
</tbody>
</table>

Both the men's huts and the married quarters were provided with adequate means of ventilation. The authorized issue of single beds for children over 5 years of age, now allowed in type A quarters, had not been made at the time of the epidemic. Single beds for children are not issued in type B and C married quarters, under existing regulations.

**Effect of sterilizing drinking and eating implements with hot water after washing up.**

Dr. J. G. Cumming claims that indirect transmission of influenza germs, by means of water used for washing up, is the most important source of infection amongst troops, and if this channel is efficiently blocked, other causes of infection may be disregarded. In support of this argument he quotes a group of 3,115 American troops, whose washing up of mess kit in 1918-19 was carried out in water of a temperature ranging from 76° to 100°, and compares the incidence of influenza and other droplet infections amongst them, during a period of ten months, with the case incidence amongst 2,856 men who used lukewarm water. He states that the ratio of cases in the protected and unprotected groups was as follows: Meningitis, 1 to 28; diphtheria, 1 to 2; measles, 1 to 17; influenza, 1 to 4; pneumonia, 1 to 8. 85 per cent of the cases of saliva-borne diseases occurred in the unprotected group.

At Longmoor great difficulty was found in getting sufficient hot water of the required temperature for sterilizing a large number of plates. Steam was not available.

One group of 230 men, whose washing up arrangements were at times faulty, had 10 cases of influenza spread over the whole epidemic period, whilst a group of 275 men had 7 cases until their arrangements were improved, and then they had none. How far this was due to the washing up...
and how far to other causes, I am unable to say. In both groups cresol solution was added to the hot water used for sterilizing the plates.

I am not aware of any more recent work on this subject.

Effects of Prophylactic Inoculation.

The troops at Longmoor had a high percentage of prophylactic inoculations during the winter of 1930-31. Inoculations were commenced on November 18, 1930, and continued during December and January, 1931. Six hundred and forty-three "other ranks" received one dose of 0.5 c.c. of the War Office "mixed cold vaccine," whilst seventy-one received treble that amount, i.e., 1.5 c.c. in two doses. 93 men were un inoculated. The average strength of the Longmoor garrison during the epidemic period, January to March, 1931, was 627 other ranks. The discrepancy between this figure and the number of men inoculated is due to daily fluctuations in strength on account of arrivals and departures from and on furlough, or transfer to other stations.

Table B shows the incidence of influenza and bronchitis at Longmoor.

Table B.—Incidence of Influenza and Bronchitis at Longmoor during January to March, 1931, as compared with incidence amongst two control units stationed at Bordon, who were not inoculated with prophylactic vaccine.

<table>
<thead>
<tr>
<th></th>
<th>Station</th>
<th>Average Strength</th>
<th>Inoculation State</th>
<th>Cases of Influenza</th>
<th>Cases of Bronchial Catarrh</th>
<th>Combined Number of Cases of Influenza and of Bronchial Catarrh</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Longmoor</td>
<td>627</td>
<td>One dose, 80 per cent</td>
<td>17</td>
<td>1</td>
<td>25</td>
<td>Nil</td>
</tr>
<tr>
<td>2</td>
<td>Unit</td>
<td>8 and 10 Rly. Coys., R.E.</td>
<td>Two doses, 9 per cent</td>
<td>12</td>
<td>17</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Average</td>
<td></td>
<td>NInoculated, 11 per cent</td>
<td>9</td>
<td>1</td>
<td>22</td>
<td>Nil</td>
</tr>
<tr>
<td>4</td>
<td>Bordon</td>
<td>388</td>
<td></td>
<td>388</td>
<td>74.75</td>
<td>74.75</td>
<td>36:68</td>
</tr>
<tr>
<td>5</td>
<td>Bordon</td>
<td>378</td>
<td></td>
<td>378</td>
<td>26.89</td>
<td>26.89</td>
<td>89.71</td>
</tr>
</tbody>
</table>

Note: The numbers for Longmoor are based on the average strength during the epidemic period, January to March, 1931.
during the epidemic period and compares it with similar data of two control uninoculated units stationed at Bordon.

Table C shows the relative number of cases of influenza and bronchitis which occurred at Longmoor amongst men who received one or two doses of mixed cold vaccine, as well as amongst men who were not inoculated.

**Table C.—Incidence of Influenza and Bronchial Catarrh amongst Inoculated and Uninoculated Troops at Longmoor from January 1, 1931, to March 31, 1931.**

<table>
<thead>
<tr>
<th>1. Dose of mixed cold vaccine administered</th>
<th>1 dose of 0·5 c.c.</th>
<th>2 doses of 1·5 c.c. in all</th>
<th>Nil</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Numbers inoculated</td>
<td>643</td>
<td>71</td>
<td>Uninoculated, 93</td>
</tr>
<tr>
<td>3. Cases of Influenza—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Number treated in barracks, including men detained in Reception Station</td>
<td>15</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>(b) Number treated in hospital, including men treated in married quarters</td>
<td>3</td>
<td>Nil</td>
<td>1</td>
</tr>
<tr>
<td>(c) Total number of cases of influenza</td>
<td>18</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>4. Cases of Bronchial Catarrh—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Number treated in barracks, including men detained in Reception Station</td>
<td>1</td>
<td>Nil</td>
<td>1</td>
</tr>
<tr>
<td>(b) Number treated in hospital, including men treated in married quarters</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>(c) Total number of cases of bronchial catarrh</td>
<td>1</td>
<td>Nil</td>
<td>1</td>
</tr>
<tr>
<td>5. Combined Number of Cases of Influenza and of Bronchial Catarrh—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Number</td>
<td>19</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>(b) Ratio per mille</td>
<td>*29·55</td>
<td>†14·08</td>
<td>†53·88</td>
</tr>
<tr>
<td>6. Number of cases with pneumonic...</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>7. Total mortality</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

* Calculated on 648 men inoculated with one dose of 0·5 c.c.
† Calculated on 71 men inoculated with 2 doses of 1·5 c.c. in all.
‡ Calculated on 93 men uninoculated.

The general precautions against "droplet infection" outlined in Appendix I of this article were in force both amongst the Longmoor units and the controls stationed at Bordon; whilst, in addition, permanganate of potash gargles were used daily by the troops under supervision, before the morning parade.

At Longmoor, a careful record was kept daily of men reporting sick with influenza or bronchitis, showing state of inoculation, and of the huts occupied and dining halls used by each case.

As regards Table B, the figures for influenza considered separately show that the troops at Longmoor, of whom only 9 per cent were fully inoculated, occupied an intermediate position as regards incidence of this disease to the two uninoculated control units stationed at Bordon.

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Table C shows that all the influenza cases at Longmoor, with the exception of one, occurred in the uninoculated or in the partially inoculated groups.

If influenza and bronchial catarrh are considered together, the Longmoor troops, in contrast to the Bordon controls, were more favourably placed. The ratio per mille of the combined influenza and bronchial catarrh figures was 39·71 per mille at Longmoor, as opposed to 103·5 and 58·2 respectively for the two control units.

This is in keeping with what was expected from the use of a mixed cold vaccine for influenza prophylaxis. It contains no antigen to influenza virus; its value lies in its effect on concomitant catarrhal and pneumonic infections which complicate that disease. When administered in single non-repeated doses of 0·5 c.c., it seems to have been of transient benefit; when the dose was doubled and repeated its value was much more marked.

There was only one case of influenza amongst the men at Longmoor who received two doses of the vaccine. There were no cases of pneumonia, whilst in the control Units at Bordon there were three. In neither station was there any death from the disease.

Although these results are encouraging, the figures quoted are too small to permit of conclusions to be drawn from them as to the probable value of prophylactic inoculations against influenza when dealing with large bodies of troops. They can only be used to show the effect of inoculations employed with general methods of prophylaxis against influenza on a small scale.

In taking these figures into consideration, it must be observed that the beneficial results were not entirely due to the effect of the vaccine alone. The precautions outlined in Appendix I of this report were carried out both among the inoculated and among the uninoculated men, but in the case of the former, a careful record of each case was made at the time of its occurrence on an appropriate form. This permitted the source of the infection to be investigated without delay and any failure in the precautionary measures adopted to be at once remedied. Unfortunately the number of observations is limited and does not permit of conclusions being drawn as to the value of prophylactic therapy on large bodies of troops.

The higher percentage of cases of influenza amongst occupants of married quarters, where general precautionary methods were less adequately employed, leads me to believe that inoculation alone was only one of the factors in diminishing the incidence of the disease.

**SUMMARY.**

I have given a bird's-eye view of the unsatisfactory position of our knowledge of influenza. I have pointed out the need for further clinical and bacteriological research. My observations at Longmoor show the beneficial effects obtained in a small station by the use of prophylactic anti-catarrh vaccine, when given in adequate dosage, and when combined with general precautionary measures against the disease.
ACKNOWLEDGMENT.

I owe thanks to the D.D.M.S. of the Aldershot Command for permission to publish this study and for the extract of general precautionary measures used against influenza in this Command.

I am indebted to Lieutenant-Colonels C. E. W. S. Fawcett, W. C. Smales and H. L. Howell for some of the data, as well as to Serjeant J. Wallis and Corporal Turner of the R.A.M.C.

I acknowledge help given by the Librarian of the British Medical Association in looking up literature.

BIBLIOGRAPHY.

Leishman, Sir William. "Research in the Medical Services." Presidential Address to the War Section of the Royal Society of Medicine on October 12, 1925, Journal of the Royal Army Medical Corps, December, 1925, xiv, 401.


Emery, W. d'Este. "Use of Vaccines in Influenza." Special Influenza Number of the Practitioner, February, 1919.


APPENDIX I. PRECAUTIONS AGAINST INFLUENZA.

EXTRACT FROM ALDERSHOT COMMAND ORDER NO. 43, DATED JANUARY 8, 1931.

Officers Commanding units will ensure that the following preventive measures are taken as far as practicable:

(i) That all ranks of their units who suffer from bad or feverish colds, sore throats, etc., report sick immediately.

(ii) That overcrowding is avoided. In barracks and huts, a minimum of sixty square feet of floor space and six feet of wall space per bed will, where possible, be allotted. Beds will be separated by a space of at least three feet. Where wall space does not permit of this distribution of beds, alternate beds will be turned so that the occupants are separated by as much space as possible.

As influenza infection is usually spread by infected men coughing and sneezing on to others, it is obvious that this "spacing out" of beds is all-important.

(iii) That all ranks are warned not to attend crowded places of amusement in civil areas whilst influenza is prevalent.

(iv) That free ventilation of all barrack rooms, huts, recreation rooms, institutes, etc., is ensured. The upper sashes of windows in these rooms will always be kept open to the extent of, at least, one foot, except in inclement weather, when those on the windward side may be closed. During the time barrack
rooms, huts, recreation rooms, institutes, etc., are vacated in the morning, the upper and lower sashes of the windows will, weather permitting, be opened wide for at least one hour in order to flush thoroughly each room with fresh air.

(v) That sawdust is spread on the floors of rooms used for band practice, and that, immediately after the practice the sawdust is swept up and burned.

(vi) That, after use, all drinking vessels, eating utensils, knives, forks, spoons, etc., are washed in the ordinary way and then sterilized by immersion in boiling water.

(vii) That, in order to avoid chills, all occupied barrack rooms, huts, recreation rooms, institutes, etc., are kept at a reasonably warm temperature.

(viii) That the floors of barrack rooms are not scrubbed more often than is essential. Frequent wet scrubblings are not necessary and dry scrubblings should be substituted. When wet scrubbing is necessary, it will be done early in the day, as little water as possible being used. Creosol will be added to the water used for scrubbing so as to make a solution of \( \frac{2}{5} \) per cent. The floor will be carefully dried after scrubbing. Wet scrubbing will only be done on a fine day. Before scrubbing is commenced, fires will be lighted and windows opened wide.

(ix) That the danger of wearing wet clothing, socks, boots, etc., is impressed on all ranks, and men be urged to change wet clothing, socks, boots, etc., at the earliest opportunity. After sweating heavily, men will be encouraged to have a rub down with a towel and to put on a dry vest.

Overcrowding in cinemas and other places of entertainment is not permitted. The numbers admitted will be limited to the normal seating accommodation.