toms detailed above appear, or the culture shows gas production, do not hesitate to remove dressings at each inspection. At least once daily take smears from inside the wound for bacterial count.

**Antitoxin.** Numerous antitoxic sera were used by the French as prophylactic and curative agents with encouraging results. Sacquipée\(^5\) advises that treatment begin at once with a polyvalent serum, followed by the serum for the particular strain of bacillus as soon as that is determined by his method of inoculating guinea pigs with material from the wound, against known antitoxins—the pig that gets the right one lives, the rest die. In 191 cases of the disease 86.91 recovered. Preventive value is also claimed for the polyvalent serum.

Antitoxin cannot, however, be said to have gained widespread confidence, nor is it at present available for general use. Prompt and thorough operative treatment is still the only safe reliance and its efficiency is so high that it can be safely neglected for no other method.

**TREATMENT AFTER DISEASE HAS DEVELOPED.**

This is, of course, operative, the type of operation must depend upon the stage the disease has attained when it is recognized, and the choice of operation requires nice judgment on the part of the surgeon. If it be discovered in the early, local stage, the procedure should be free opening of the involved areas with careful anatomical separation of fascia layers down to the bone, avoiding major circulation channels, and excising all the devitalized muscle, which can be recognized by its brick red color, friability and failure to contract when pinched or cut. It may be necessary to excise the entire belly of a muscle or a whole muscle group. Most writers advise long longitudinal, but Hugh Cabot\(^6\) advises transverse incisions. Then carry out the Carrel-Dakin method as advised above.

If not recognized until the explosive stage, when the limb is massively swollen, crepitant and discolored, the wise operator will unhesitatingly amputate by the guillotine method well above the involved areas although at times the extension may be greater on one side than the other and the amputation may be oblique, saving enough skin for a secondary covering in.

With these methods of treatment, even without the aid of preventive serum, gas gangrene is a preventable complication. The difficulty is that in civil practice we are not accustomed to anticipate its occurrence, so are satisfied with less radical primary treatment, protecting against tetanus by means of that valuable antitoxin. In the light of our experience at Worcester City Hospital it seems to me that we must disabuse our minds of complacency in respect to this infection and carry it upon our consciences to make our preliminary treatment of wounds of this character 100% efficient, and our post-operative care sufficiently keen and wide-awake to detect it while it is yet in the local stage, thereby saving our patients from mutilating operation or loss of life.

[**Note.** In the discussion following the reading of this paper Dr. B. H. Alton reported a case now under his care at Memorial Hospital caused by a gunshot wound of the popliteal space, which he had saved by mid-thigh amputation. He pointed out the importance of acidosis as a factor in the rapidly fatal character of the disease and said that 1000 cc. of 2% sodium bicarbonate solution intravenously was of greater value than transfusion. He also remarked that in his case the infection seemed less virulent than the many he had experienced on the Flanders front.]

Dr. P. H. Cook said that roentgenologists distinguish two forms of gas infiltration, one being characterized by extension along fascia planes perhaps in but one sector of a limb, the other characterized by extension also through the muscles in the interfibrillar spaces, giving a massive emphysema involving whole muscle or muscle groups. The former offers more favorable opportunity for conservative surgery while the latter requires extensive operation or amputation.]

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**THE "COMMON COLD" IN RELATION TO CERTAIN MICROORGANISMS AND ITS TREATMENT WITH BACTERIAL VACCINES.**

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The term "common cold" is used in this connection to describe the infection of the various respiratory passages seen so commonly here in the winter.
During the past five years increasing attention has been centered in acute respiratory infections on account of a number of epidemics of increasing severity which have occurred in various parts of this country. Scientific interest has somewhat lapsed in this matter since the demonstration by Pfeiffer in 1890 of the influenza bacillus, and its designation as the cause of that group of symptoms commonly termed "la grippe." Confirmation of Pfeiffer's findings by Kitasato, Pfuhl, and Cannon, together with other observers, led to the belief that this organism was primarily responsible for practically all the severe winter infections of the upper respiratory tract. Prior investigations by Weichselbaum, Ribbot, Bouchard and Saecond, who had found from bacteriological investigations, streptococci and pneumococci as the predominating organisms in this class of disease, were discarded, and it has only been through a re-investigation of this subject that the true place of the influenza bacillus in respiratory infections has been proved. Since 1894, there have been an increasing number of observations, among which may be cited those of Kleinbeger, Krause, Lord and Bezancón, who have investigated the connection of the influenza bacillus with acute respiratory disease, and while at times finding the organism of Pfeiffer, have with much greater regularity, found streptococci and pneumococci, together with other organisms, in abundance.

Investigations of the "common cold," by anaerobic methods and the search for a filterable virus as an etiological cause, have given rise to some interesting observations. In cases of rhinitis, Tunniclifff has described a small microorganism, which she found fairly regularly in the early stages of acute coryza. Experimental work with dogs has shown that fairly typical attacks might be produced with this microorganism.

The work of Krause, more recently supplemented by that of Foster, on the question of a filterable virus in cases of rhinitis has shown that by means of filterable products in acute nasal infection, substances were obtained which, experimentally in human beings, would reproduce the infection when inoculated into the nose.

A widespread epidemic of acute respiratory infections, occurring generally in this country during the winter of 1915-1916, was carefully investigated by Mathers in Chicago. As a result of the use of aerobic, anaerobic and filtration methods in a study of some sixty-one cases the organisms found greatly to predominate were the hemolytic streptococcus, the streptococcus viridans, and the pneumococcus. The presence of the bacillus of influenza occurred only in one case.

The work of Dochez, Gillespie, Avery, Stillman and others on the pneumococcus have brought out many facts in regard to the presence of this organism in the upper respiratory passages. Stillman, in a study of 390 normal individuals, found that in the saliva fully one-third carried a pneumococcus, the more avirulent types predominating. Dochez and Avery in a study of contacts in cases of pneumonia found that a very considerable percentage became carriers of virulent types of the pneumococcus.

These and other investigations point to the importance of those organisms included in the groups of streptococci and pneumococci as playing a predominant rôle in acute respiratory diseases rather than certain other microorganisms, such as the bacillus of influenza.

The present work, which runs back several years, has concerned itself almost entirely with a study of the streptococcus and pneumococcus groups of organisms as they have appeared in various phases of the "common cold." This work was begun during the winter of 1913-14 and continued during the winters of 1915-16-17-18. An effort has been made to determine the type of "common cold" in relation to the presence of one of the members of the pneumococcus or streptococcus groups, and to see what could be done to control these various infections by the use of bacterial vaccines. The types of streptococci encountered have been determined through their action on blood agar, fermentation of a variety of sugars, and their virulence, in some instances, toward animals.

For the last three years, where the pneumococcus has been encountered, a study of types has been carried on in connection with therapeutic measures.

METHODS.

On account of the large bacterial flora commonly found in the naso-pharynx every effort has been made in this study to secure culture material as early as possible after the onset of
the disease. Those cases included in this series are, therefore, only those in which such material was secured within thirty-six hours of onset, and this in part accounts for the irregular distribution of the type of cases studied. In those cases where the time elapsed from the onset of the infection was a matter of a few hours, cultures were secured through means of protected swabs from the turbinate region in cases of coryza, from the soft palate in cases of a burning red throat and from washed bits of tracheal or laryngeal secretions where the onset of the disease pointed to an infection in this location.

Aerobic and anaerobic cultures were planted in plain broth, acetic broth, litmus milk, blood agar, dextrose agar and dextrose acetic agar. At the end of eighteen to twenty-four hours isolated colonies were transferred and pure cultures of pneumococci or streptococci were tested for animal virulence, then action on blood agar and fermentation of sugars. In many instances, a number of strains of these organisms were studied in each individual case. Where a local epidemic was in progress in an institution as many cultures as possible were studied by these methods to determine if there was a common organism present as an etiological factor.

During the winter 1913-14 in a series of seventy selected cases where there was an invasion of the upper respiratory passages, sixteen showed an initial infection in the tonsillar region, forty on the uvula and soft palate, four on the mucous membrane of the nose, and ten in the larynx and trachea.

During the fall and winter of 1914-15 a series of thirty-five cases was investigated, a few being taken each month, beginning with the month of October, in order to note any change in the type of organisms in these infections during the winter months. A summary of this investigation shows the predominating organism to be hemolytic streptococcus in twenty-three observations, the streptococcus viridans in five, a non-hemolytic streptococcus in sixty-one and the pneumococcus in twenty.

During the winters of 1915-16-17-18, similar work has been carried on chiefly among cases of acute laryngitis and tracheo-bronchitis. The pneumococcus has been most commonly found, Type IV predominating; although Types I and II have not been infrequent. The same organism was obtained in some twenty-five cases of laryngitis and bronchitis occurring in the late spring of the year. The pneumococcus thus recovered was almost entirely of the Group IV variety, and, following Olmstead’s serological classification, most of them fell in the first twelve subgroups.

As a result of observations carried on during the past five years, it has seemed possible to divide the common cold roughly into the following clinical types:

a. Acute rhinitis.
b. Acute pharyngitis. Followed by rhinitis and laryngitis.
c. Acute laryngitis. Followed by tracheitis, bronchitis, and pneumonia.
d. Acute tracheitis. Followed by bronchitis and laryngitis.

Acute rhinitis is characterized by sudden swelling of the nasal mucous membrane, with a watery discharge, fullness in the head and general malaise. The organism commonly found in the secretion belongs to the staphylocoecus group, and somewhat less frequently the hemolytic streptococcus has appeared.

Acute pharyngitis is characterized by redness and swelling of the fauces and of the posterior wall of the pharynx, pain on swallowing, dry cough and temperature. The infection may extend into the nose or larynx. Almost invariably, the initial infection is produced by the member of the streptococcus group. The types of cold beginning with laryngitis or tracheitis and followed by a rapid extension over the respiratory tract are closely related and generally due to one and the same microorganism. Aside from the local symptoms, the type is accompanied with considerable muscular pain, and the name of grippe is commonly applied to it.

The pneumococcus of the Group IV, or occasionally of the Groups I and II, is predominant. Occasionally, however, the hemolytic streptococcus has been the original invader. The early fall and winter colds are generally of the first types. The early and late spring colds are of the last two types.

The type of cold originating as laryngotracheitis has frequently appeared in epidemic form in many large cities, and, on account of the severity of its manifestations, some observers have considered it to be due to the bacillus of influenza.

In securing cultures during the first hours of an infection it is generally possible to determine the predominating factor before various other-
microorganisms, commonly present in the nasal and buccal mucous membrane, have had time to multiply.

The work of Dochez and Avery on the question of the epidemiology of the pneumococcus demonstrates how readily even the virulent strains of the organism are transmitted from person to person and, as Valentine has pointed out, the large numbers of this organism in the secretions of many respiratory infections makes its etiological relationship very suggestive.

It would seem futile on account of the multiplicity of the organisms commonly present and constantly changing on the mucous membranes of the nose and throat to expect that all acute respiratory infections might be due to one microorganism. The filterable virus obtained by Krause and Foster may in some instances be productive of a typical choryza. The anaerobic bacillus of Tunnieliff similarly may be a factor in the production of acute respiratory disease. In other instances, however, these and many other bacterial observations go to show that in the group of streptococci and pneumococci we have at least two of the predominating etiological factors in our winter colds whether primary or secondary.

USE OF BACTERIAL VACCINES.

In view of the fact that so many observers have reported a great predominance of the streptococcus and pneumococcus in various manifestations of the "common cold," and, further, as many of the complications which arise secondary to it have as the predominant organism one or more members of these groups, it seemed worth while to see if something could be done by the simple method of the use of bacterial vaccines to control this type of infection.

In view of the prevailing feeling among bacteriologists that immunity to the streptococcus and pneumococcus is of a very temporary nature, the effort to devise a means of mitigating the effects of the severer colds necessitated the working out of a method of producing some degree of resistance to these groups of organisms which appear so commonly. During the past three winters, 1916-17, 1917-18, 1918-19, a series of observations have been carried out on the use of bacterial vaccines in the treatment and control of acute colds. The type of cases largely dealt with has been that of a person peculiarly susceptible to acute respiratory infection, and, who, on account of this and the incapacity so produced, is willing to adopt any measures that promise relief. The majority of persons in normal health suffer during the course of a year one or more colds, generally in the form of coryza, or as a laryngobronchitis during the late spring months. There is, however, an increasing number of persons in the community where this average is many times exceeded; so much so that in the worst cases a renewed infection may occur every ten days over a period of six or eight months.

While the majority of people will, as a result of an intracutaneous test for sensitization, show a relative susceptibility to one or more of the common microorganisms associated with colds, such cases as those cited will give evidence of marked hypersusceptibility sometimes to one organism, frequently to more than one. This can be shown not only as the result of the intracutaneous test, but has been more fully demonstrated following the subcutaneous inoculation with bacterial vaccines. At times not only marked local reaction occurs, even with a dose well below the average, but constitutional symptoms are also pronounced. This hypersusceptibility apparently explains the cause of many repeated colds, especially from these microorganisms which confer little resistance. It has been noticeable, however, that at times following an acute cold the resistive powers of the individual to the specific microorganism are at least temporarily greatly increased, as shown by their decreased susceptibility, than before such an infection.

The method devised has been as follows:

The isolation of members of the staphylococcus, streptococcus and pneumococcus from cases where the infection has been severe, and the preparation of bacterial vaccines from each one of these types of organisms. Therapeutically, early in the fall, three or four inoculations are given of a combination of the vaccines of the streptococcus and staphylococcus groups. In the early part of the winter, a second series of inoculations is given with a combination of the vaccines of the members of the streptococci and pneumococci groups, and this is repeated in the early spring. Should a cold develop in the interim, the patient is urged to present himself for inoculation during the first twelve hours of the onset of the infection. One or two inoculations will occasionally bring the
cold to a rapid termination. In those cases where abortive colds appear, or where, in spite of inoculations, an extensive infection develops, microorganisms are studied in each instance, and autogenous preparations made and used in subsequent inoculations.

The results of this method have been in some instances unsuccessful, but in the majority the inoculations have materially modified the severity of the types of colds usually endured, and have diminished their frequency. In some individuals practical immunity from acute respiratory infections has been secured. This has been especially the case in those individuals, who have an abnormal susceptibility to this type of infection, and in whom it is not uncommon to see one cold rapidly succeeding another.

The initial work in prophylaxis against pneumonia was inaugurated by Lister in South Africa among the workers in the diamond mines. The result of his observations shows the possibility of the protection of a considerable part of the community by bacterial inoculation through lessening the number of carriers, and, perhaps, the virulence of the strains found in the community.

The recent publication of the work of Cecil and Austin on the results of prophylactic inoculation against the pneumococcus points to the possibility that something can be accomplished in curtailing infections produced by this organism through the injection of large amounts of a combination of types of this microorganism.

Eaton secured favorable results by the use of vaccines in infections of the nose and sinuses where, primarily, the disease was due to the streptococcus, pneumococcus and the bacillus of influenza. It would, therefore, seem, as the result of these observations and those of other observers, that active immunity, even though of temporary duration, may be produced through the use of bacterial vaccines for the members of the streptococcus and pneumococcus groups. Careful study of the microorganisms most commonly concerned, in the individual case, in the production of acute respiratory infections, with the use of frequent inoculations in large quantity of the various types of the microorganisms concerned, promises results not only in the suppression of the common cold, but, also, to go a long way as a prophylactic measure in the relief of its various complications.

**CONCLUSIONS.**

1. The results of many recent observations point to the predominant place of members of the streptococcus and pneumococcus groups in the etiology of infections of the upper respiratory tract.

2. General classification of the various types of the "common cold" is suggested, and these rest on a fairly constant bacteriological basis.

3. The production of an active immunity through the use of appropriate bacterial vaccines promises to be of value prophylactically in the control of infections of the upper respiratory tract.

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**X-RAY DIAGNOSIS AND THERAPY.**

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More and more in my work I realize the limitations as yet bounding all our human endeavors, especially in the field of medical science. The more x-ray work I do the more I realize how much I do not know about medicine and especially about x-ray interpretation. We radiologists do a great many times make brilliant diagnoses; we discover entirely unexpected and interesting lesions; we get gratifying results with our x-ray treatments; we find almost daily something interesting and unusual, something puzzling, and a great many times we battle against discouragements none but radiol-