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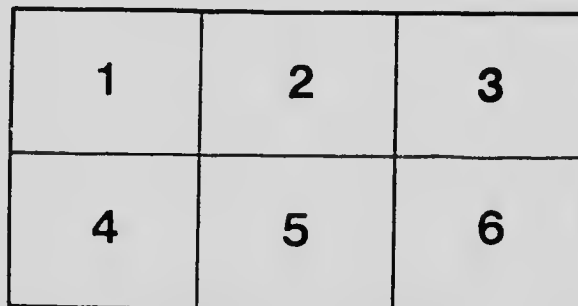
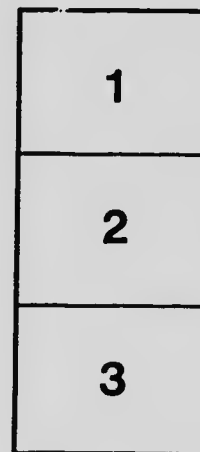
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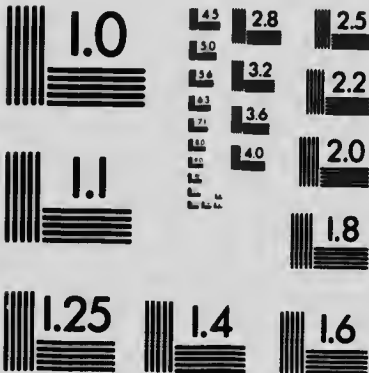
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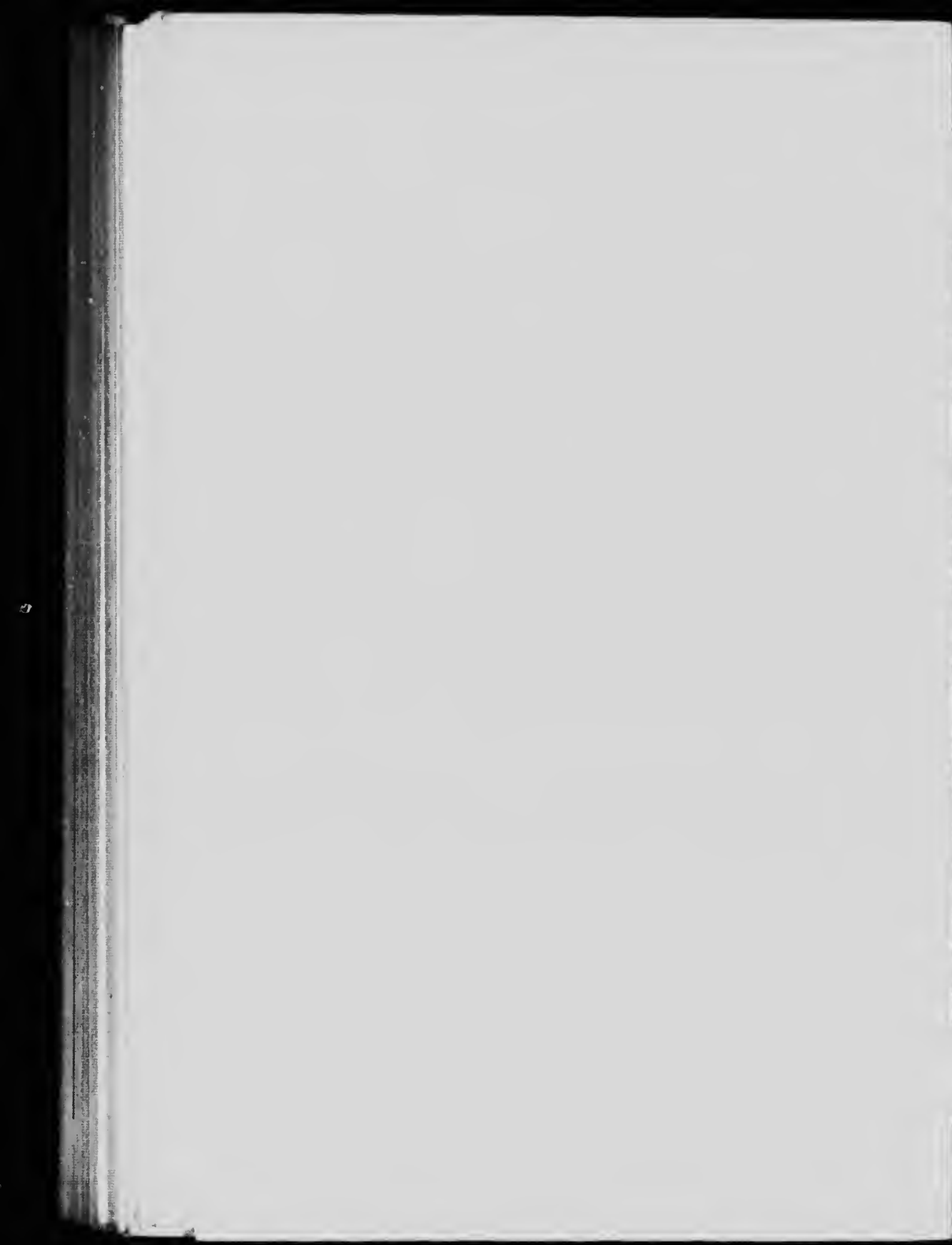
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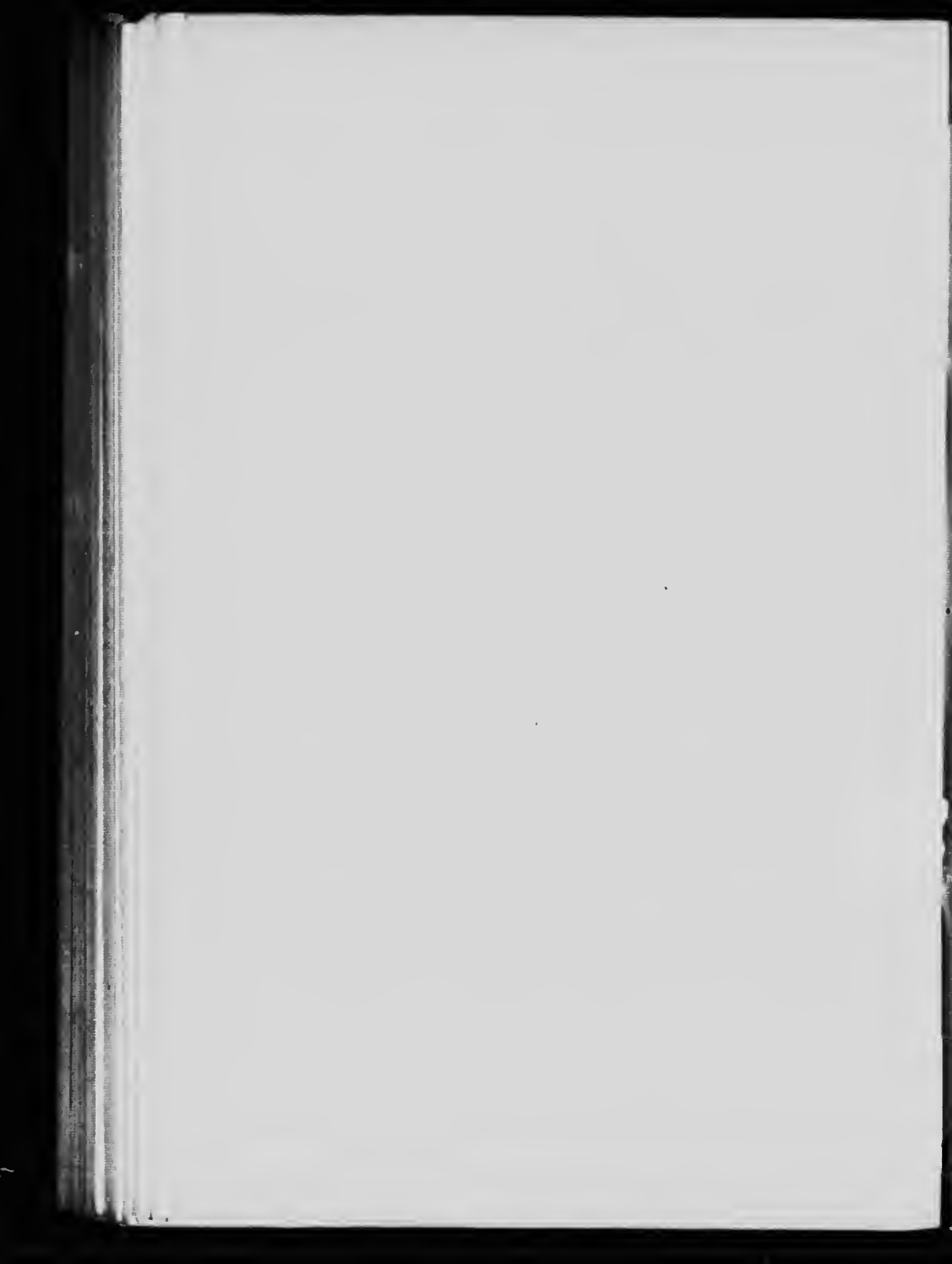
# R O U P

BY

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## Ontario Agricultural College and Experimental Farm

## R O U P .

By PROF. F. C. HARRISON and DR. H. STREIT, Bacteriological Department of the Ontario Agricultural College and Experimental Farm.

The most widely spread and destructive disease affecting domestic fowls in Ontario, and perhaps in Canada, is commonly known as *Roup*, Canker, or Distemper. By some, the disease is called Cancer of the Mouth, Throat, etc., or even by the name of Fowl Diphtheria: but all these different names are given to the same disease, according as some particular symptom is more or less prominent

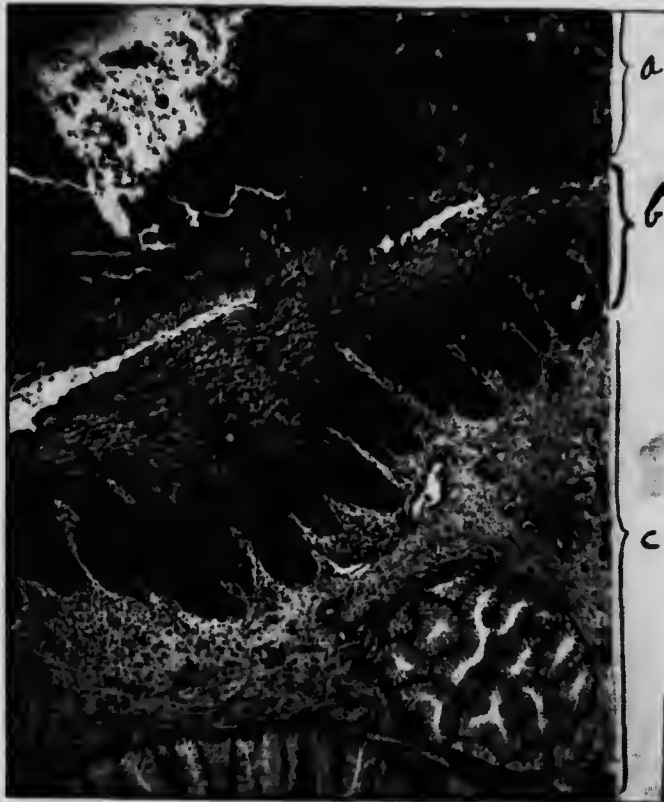


Fig. 1.—A section of false membrane of a rumpy fowl. *a* False membrane. *b* Epithelium. *c* Submucosa.

*Economic Importance.* The economic importance of this disease is very great, as it is probably one of the greatest hindrances in the



poultry business. The direct losses from the disease vary greatly in different epidemics. Thus, in a virulent outbreak, there may be many deaths in a short time; while, in another, a flock may become infected and only a few birds die. Of much greater importance are the indirect losses; and these are apt to be overlooked by farmers or those who keep only a few fowl and pay but little attention to them. The diseased birds recover very slowly; and they remain thin, anæmic, and unfit for egg production, fattening, or breeding,—eating just as much as if they were normal and living at the expense of their keeper.

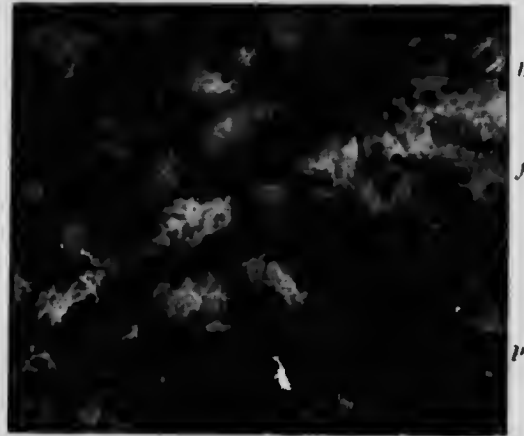


Fig. 2.—Section of a false membrane (portion of (a) Fig. 1, more highly magnified) showing pus cells (*p*), fibrous exudate (*f*) and bacilli (*b*).

#### GENERAL CONDITION OF ROUPY BIRDS.

The general condition of rousy birds varies very much. After the first symptom of the disease, which is usually a putrid catarrh from the nostrils, the affected fowl is generally restless, separates from other members of the flock, becomes dull, cowers in the corner of the coop, or mopes in the corner of the pen, with its head drawn close to its body and often covered with its wings.

If there is a severe discharge from the nostrils or eyes, then the feathers upon the wings or back are likely to be smeared with it, stick together, and after some time fall out; and the eyes are often shut, the lids being glued together by the sticky discharge from them.

A fowl in a sleepy condition, or moping as described, frequently rouses itself for a time, takes food, and especially water, and then gradually returns to the apathetic condition.

Many fowls having the disease in a chronic form keep their normal appetite for a long time, and seem very little disturbed physi-

cally, whilst others, especially when the face or eyes become swollen, lose their appetite, grow thinner and thinner, and finally become too weak to stand or walk around, when they lie down and die in a few days. During the last stage, diarrhoea, with offensive yellow or green discharge, often sets in and causes death in a short time.

Many poultry keepers assert that roup birds show fever; and it is certain that the head is very often hot, but the body temperature is normal, or only very slightly higher than normal.

#### SPECIAL SYMPTOMS OF ROUP.

By the term Roup we generally understand a more or less putrid discharge from the nostrils, which lasts for weeks or even months. The disease often follows a common cold, to which fowls, especially



Fig. 3. — Pigeon (No. 6) thirteen days after inoculation with the roup bacillus and two days before death.

young fowls and those of the more delicate breeds, are much predisposed.

In the first stages of Roup, the birds often cough or sneeze, and the breathing is noisy, caused by the partial closing of the air passages, which become blocked with the discharge from the nostrils. When the air passages are entirely closed by the discharged products, the fowl has to open its beak in order to breathe.

Sometimes a yellowish cheese-like mass forms in the nostrils, growing quickly and pressing the upper walls of the nose upwards; and if this mass is removed, an uneven bleeding surface is left, which forms a new cheesy mass in from 24 to 48 hours.

Whilst many roup birds show only the above mentioned symptoms, others become more seriously diseased. The face of roup birds is very often swollen, especially between the eyes and the nost-

ribs ; and this swelling, which is hot and sore, sometimes grows into a tumour as large as a walnut,—generally firm and hard. A bird in this condition is frequently found scratching at the tumour with its claws or wings, as if endeavoring to remove it. If the tumour grows on the inner side, towards the nasal passage, it forces the roof of the mouth downward, and the upper and lower beak are slowly pressed out of their normal position, so that the bird cannot close its mouth.

On making an incision into the tumour, we find a solid, cheesy, yellowish matter, which may be pulled out like the root of a plant ; but it usually has to be broken into small pieces in order to get it out. Around this mass, there is a more or less smooth, grey or brownish membrane that is capable of again forming a cheesy mass similar to what has been removed.

The mass itself, when not attended to, often grows into the nasal canals, and blocks them up completely. Generally, combined with the formation of the tumour on the face, there is an affection of the eyes ; or the eyes become diseased without the preliminary discharge from the nose, in which case poultry keepers speak of fowls as suffering from " Roup of the Eyes."

*Roup of the Eyes.* The first symptom of the eyes is generally an inflammation of the eyelids. These become red, swollen, and hot ; then the mucous membrane and glands of eyes become inflamed and begin to secrete a liquid,—at first clear, and then of a grey slimy, putrid character. Occasionally the mucous membrane of the eye socket is the primary seat of the infection of the eye, and the eyelids swell as a secondary symptom. It is easy to understand that the eyes may become infected from the nasal cavity, as the eye socket has free connection, by means of the lachrymal canal, with the nasal cavity, and thus the diseased products from the nostrils can pass into the eye sockets.

The secretion from the eyes is similar to that described as coming from the nostrils, *i. e.*, at first a clear liquid, then changing to a putrid grey and offensive discharge, which dries on the feathers at the side of the head, causing them to stick together or fall out. If the secretion is retained in the eye socket, it undergoes a change, becoming a yellowish, solid, cheesy mass of the same appearance as that found in the nasal tumour. This cheesy mass either forces the eye out of its socket, or the inflammation entirely destroys it. These cheese-like masses form in one or two days, and may reappear after many daily novals.

All these affections, described above, may be localised on one side ; but often both nasal passages and both eyes are affected at the same time.

Combined with the symptoms of roup above described, there often are patches of a greyish yellow exudation firmly adherent to the mouth, throat, etc. These patches are called " false membranes " ; and

on account of their somewhat close resemblance to the membrane which is formed in human diphtheria, it has been thought by some writers that the avian and human diseases are the same. Here, however, let it suffice to say that the weight of evidence is against this contention; but this phase of the subject will be more fully dealt with later on in this bulletin.

We may also point out that many poultry keepers who notice the false membrane on the throat and mouth of their fowls, regard the disease as quite different from the entarrhal form and call it "canker", which is probably a popular form of the word "cancer".

Whether the disease is characterized by false membranes, offensive discharge, or cheesy masses, the cause is the same, as we have many times experimentally demonstrated.



Fig. 4. Hen 47; sixty-seven days after inoculation with *B. pyocyaneus*; and the day before death.

At one or several places in the mouth or throat, these yellowish, smooth or uneven membranes appear, and either remain small and disappear after a few days, or grow thicker, spread, and become firmly attached to the mucous membrane; and if they (the false membranes) are removed, an uneven, bleeding surface is exposed, which looks like a true cancer.

After the appearance of the membranes, the adjacent submucous tissue sometimes becomes inflamed, and finally the growths are found to be similar to those so often seen at the side of the face,—containing solid cheesy matter in the centre.

When the throat is blocked by these false membranes, the animal's breathing becomes abnormal, and the air passing through the throat produces loud noises. Gradually, the visible mucous membrane and the comb turn blue, and the fowl finally dies from suffocation.

The symptoms are much the same when the lungs are the seat of the disease. In dead roup-y fowls we have often found the higher bronchial tubes completely filled with solid cheesy matter, which prevented the air from passing into the lungs.

Occasionally cheesy matters are found in the folds of the pleura, and in other situations.

#### THE COURSE OF THE DISEASE.

The course of roup is usually of long duration. A simple, putrid discharge from the nose may stop in three or four weeks, and similarly false membranes may soon disappear; but generally the symptoms



Fig. 5.—Head of hen 35; eight days after infection with a culture of the roup bacillus—*a*, cheesy matter.

ast for months. When the eyelids become swollen and tumours appear, the case is usually chronic. Affected birds may be better for a few days or weeks, and then become very weak again. Damp, cold weather usually intensifies the disease.

It is well known that fowls may be more or less sick from roup for one or even several years; and these birds should have the greatest care and attention, for they are generally the cause of new outbreaks. Once introduced, roup may remain in a flock for many years. The first cold and moist nights of the fall and early winter cause all kinds of catarrhs, which in many instances are followed by roup. Roup spreads rapidly in the winter time, and may attack from 10 to 90 per cent. of the fowls in a flock. Towards spring, the disease gradually disappears; during the summer months, a few birds remain

chronically affected; and then the first cold nights give the disease a fresh start.

Young fowls and fowls of the fine breeds are especially liable to roup. While some poultry men maintain that birds once having suffered from roup never take the disease again, most of the experimental evidence tends to show that no acquired immunity exists, as sometimes happens after other diseases. Some fowls are, however, naturally immune, and never take the disease. In the course of our own experiments, a white chicken which had never had roup, was inoculated with repeated and large doses of the roup germ, but without effect.



Fig 6. Head of fowl 36; twenty-two days after inoculation with a culture of the roup bacillus—*a*, false membrane.

#### THE CAUSE OF THE DISEASE.

Many opinions have been expressed as to the cause of the disease and some of these have been based on scientific research, while others have been mere guesses. Some writers have thought that the disease is due to "Protozoa," a low form of animal life; and others have isolated various bacteria from the disease tissues, which bacteria when grown in pure culture and introduced into healthy hens, have produced symptoms of the disease.

As roup, especially when located in the mouth or throat, resembles human diphtheria, it has been claimed that the well-known organism of this disease, the *Bacillus diphtheriae* of Klebs-Loeffler, is the cause of roup, or, as it is termed by some, "fowl diphtheria."

Statements have been made by European writers that outbreaks of diphtheria occurred in men, while at the same time poultry kept in the buildings in which the men lived were suffering from roup. They, however, do not state whether the roup commenced before the diphtheria or *vice versa*, and they give no good reasons for supposing that the outbreaks were actually connected with each other. In fact, we must state that the cases referred to, of alleged transmission of chicken diphtheria to man, are on examination found to be mere assumption, due to ignorance of veterinary pathology.

In 1898, several articles appeared in the Agricultural Press, written by H. A. Stevenson, M.D., who said, "Roup is caused by a specific germ, which appears to me to be identical with the Klebs-Loeffler bacillus," *i. e.*, the bacillus which causes human diphtheria; and in another place, he says, "I believe roup and canker to be the same disease, a disease identical with diphtheria in man."

If the above statements were borne out by experiments, and found to be correct, we should have to demand the most rigorous treatment of diseased birds; for Dr. Stevenson takes the position that diphtheria may be spread by roup birds in exactly the same manner as tuberculosis is supposed to be spread by tubercular cattle.

These statements of Stevenson are, however, not based on careful experiments, and the *human* diphtheria antitoxin which he recommended as a sure cure for roup, has been found to be absolutely worthless for that purpose.

The following experiments and observations may be cited under this head:

A student of Professor Tresbot's devoured diphtheritic membrane from fowls without contracting the disease; and Löffler, the discoverer of the human diphtheria germ, and Colin were never able to produce diphtheria in fowls by inoculation with human diphtheria germs. Gratia and Lieneaux treated roup birds with the human diphtheria antitoxin, and secured very poor results.

We have also ourselves made a large number of experiments with roup fowls; and in about 300 roup birds that have come under our observation, we have never been able to isolate the Klebs-Loeffler bacillus, *i. e.*, the bacillus of human diphtheria. Roup fowls have also been again and again treated with diphtheria antitoxin without any result. Were the germs of human diphtheria and fowl diphtheria the same, the antitoxin would certainly have affected the diphtheria in the fowl, since it is the best known remedy for diphtheria in man.

Further, we find that the diphtheritic membranes in man and fowls are different. That of the former consists of a fibrinous exudation,—granular material, pus corpuscles, and debris of epithelial cells,—and contains the Klebs-Loeffler bacillus in great numbers; and these can readily be stained by Gram's method.

The membrane from fowls consists almost entirely of pus cells, some granular masses, debris of epithelial cells (especially swollen nuclei of these), and bacteria; but amongst the bacteria, we seldom find one that can be stained by Gram's method.

Roupy fowls never show any of the symptoms caused by the bacterial toxin (poison secreted by bacteria,) which usually follow an infection with the true diphtheria bacillus.



Fig. 7.—Fowl 46; throat and bottom of the mouth with false membrane (*m*), fourteen days after inoculation with *B. pyocyaneus*.

Hence we are bound to conclude, from the evidence here presented, and from other evidence we have at hand but which space alone prevents us from presenting, that *Stevenson's theory is untenable, and that fowl diphtheria is never caused by the human diphtheria germ,—* the Klebs-Loeffler bacillus.

#### RESULTS OF WORK AT COLLEGE.

In the present bulletin, only a brief summary of our work with roupy birds can be given. Any one wishing the full details of the experimental work may obtain them by writing to the College for the full report.



The first experiments were conducted, to find out *whether or not Roup was an infectious disease*; and, for this purpose, 10 healthy fowls which had never been exposed to infection, were confined in a cage with diseased birds; and after varying periods of time, five of the healthy birds caught the disease. Fourteen healthy birds were then treated by rubbing a portion of the false membrane, or putrid nasal discharge from rousy birds, upon the normal, or slightly scratched, mucous membrane of the nose or eyes; and in this way, two birds were infected with typical roup.

These experiments, therefore, show the infectious nature of the disease; but the degree of infectiousness was not large. We must, however, remember that when fowls are kept under natural conditions where they are subject to cold, etc., the infectiousness may be much increased.

Having thus shown that roup is infectious, the next step was to isolate the causal micro-organism, a task of some difficulty, on account of the fact that the discharge from the nose, the false membrane, etc., is in close contact with, and likely to be contaminated by the air and food, which always contain large numbers of bacteria that find suitable material and favorable temperature for growth in the albuminous secretions of fowl.

Very many bacteria were isolated, but when inoculated into healthy chickens, they proved to be harmless.

In other infections, such as Fowl Cholera, etc., it is comparatively easy to isolate the causal organism, because it is found in the blood and organs of the diseased fowl; but in roup we find that, as a rule, the organs and blood are free from bacteria, or else if bacteria are present, they are harmless.

Without giving the results of a long-continued series of fruitless examinations and experiments, made within the last four years, we may say that at length we have isolated a germ which causes roup, with all its varied symptoms. To this germ we have given the name *Bacillus cacosmus* (ill-smelling), and shall refer to it as the "roup bacillus." A technical description of the germ will be given in a more scientific paper at a later date.

Chronic diseases, of which we have an excellent example in roup, are notoriously hard to reproduce by the inoculation of healthy animals, because in most cases of sickness there must be, not only *the causal organism*, but a lowering of the vital forces; and, to get over the difficulty, we used pigeons, which are easily infected, to increase the virulence of the causal organism and thereby assist in the infection of hens. In this way, we produced roup in hens at pleasure by inoculation with the roup bacillus, taken from rousy pigeons.

The "roup bacillus" tends to penetrate the deeper layers of the mucous membrane or submucous tissues. Hence cultures made from swabs taken from the false membranes very rarely contain the "roup

bacillus," because the bacilli are retained in the depths of the animal tissue.

The "roup bacillus" is especially difficult to isolate in cases in which the bird has had the disease for a long time, as the tumours and false membranes contain very many other kinds of bacteria in large numbers. In our experiments, even when roup was produced in healthy fowl by inoculation with pure cultures of the "roup bacillus," the mucous discharge from the very beginning contained many kinds of bacteria.

The roup germs seem capable of remaining in a sort of dormant condition in the depths of the tissues for a long time,—so long that the fowls sometimes appear convalescent; suddenly, when the constitution is weakened by a cold or other causes, the roup germs become active and the roup symptoms re-appear.

We have also found that roup, with all its varying symptoms, can be produced by the inoculation of healthy hens with the well-known



Fig. 8.—The Roup bacillus (*B. encosinus*), from a twenty-four hour oil agar culture.

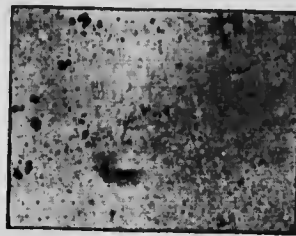


Fig. 9.—The Roup bacillus showing the flagella (organs of locomotion). Van Erniegen's method.

*Bacillus pyocyaneus*, or green pus germ, which we have frequently isolated from roup birds. Hence, it would seem that roup is simply a complex suppurative process; but, different from ordinary forms of suppuration, the pus in fowls appears in the form of a half or entirely solid, cheese-like, yellowish white mass, without any tendency to become soft or liquid, or to perforate the surrounding skin.

This may be proved by the injection of sterile turpentine (oil) into the eye-lids, which gives rise to inflammation and the formation of solid cheese-like matter in the depth of the tumour.

Therefore, the cheesy masses must be regarded as pus.

To sum up, roup, or fowl diphtheria, canker, etc., is a complex of suppurative processes, taking place especially in the head of fowls. This suppuration may be caused by different species of bacteria, and these may be very wide spread (e. g. *Pyocyaneus*), and thus an outbreak of roup may occur in a flock living in unsanitary conditions, without any previous introduction of the germs from elsewhere; but certainly this is the exception. More often, the disease is spread

by sick fowls introduced into healthy flocks. Germs generally are spread throughout a yard by means of the secretions, although these do not always contain the casual organism. The infected fowls are not very much different in their general appearance and condition at the beginning of the disease, and thus they often take food and water for a long time, contaminating the food, troughs and cups. As the germs cannot infect fowls so long as the mucous membranes are intact and healthy, the disease does not spread for a certain length of time, although the germs may be present almost everywhere in the yard. Then comes a change of weather, such as a cold night or the beginning of fall and winter,—and suddenly the infectiousness of the disease is increased and roup spreads rapidly among the birds. Unfavorable weather, which causes colds and other infections of the mucous membranes, directly opens the way for infection. But it is possible that the roup bacilli, having infected a number of fowls, may gain so much in virulence as to be capable of entering into the tissues of the fowl without previous colds. Like colds, other circumstances which weaken the constitution of the fowls, such as unsuitable feed or feeding, unhygienic yards, bad water supply, etc., contribute towards the spread of the disease. Once present in a poultry yard, the roup-causing bacilli cannot be got rid of, unless by very careful disinfection; and this is valueless so long as any of the fowls are diseased; and, as we have already stated, fowls often remain affected with roup, carrying the germs in a semi-dormant state, for months or years.

It is possible that just one kind of bacillus, for example, our "roup bacillus," causes an outbreak of roup; or an outbreak may be caused, as here at the Ontario Agricultural College, by several species.

#### TREATMENT AND PREVENTIVES.

As roup is not a specific infectious disease, that is, a disease caused by a single species of germ, it is almost impossible to prepare a preventive or curative serum. Hence this method of treating infectious diseases cannot be used in roup; and besides it would be very costly.

The germs of roup are not very resistant; they can easily be destroyed when present in cultures, or somewhere outside the animal; but in the animal tissue, they are very difficult to kill, because they penetrate into the tissue; and unless this too is killed, the germs continue living for a long time.

Roup may be cured by remedies, if the treatment is careful and judicious. Obstinate re-appearing false membranes can be successfully treated by burning the diseased tissue with a strong acid (hydrochloric acid 50 per cent. to 75 per cent.), or other caustics, such as silver nitrate. If the eyes and nose are attacked, they have to be carefully washed, at least twice a day, with an antiseptic solution such as 2 per cent. boracic acid in a decoction of chainomile flowers, or

$\frac{1}{2}$  per cent. solution of corrosive sublimate. Thus the micro-organisms are killed or, at least, the diseased products which are discharged are removed, and the irritation caused by them; also the transformation into large cheesy masses is prevented.

We had chickens badly affected with roup of the eyes, which were cured with boracic acid and chamomile. On account of the smallness of the nostrils and nasal canals, it is very difficult to get the antiseptic solutions into the nose and nose cavities; but it can be done with a small syringe. If this treatment is too troublesome, then the nostrils, at least, should be washed and opened several times a day, to allow the secretions to pass away. We have treated chickens for 14 days by daily washing with a  $2\frac{1}{2}$  per cent. solution of creolin and glycerine. After the washings, small plugs of cotton wool, filled with mixture, were placed in the nostrils and lachrymal ducts. This remedy did not cure the roup in the head, although the same mixture readily kills the roup bacillus in cultures in from 2 to 3 minutes. The greatest hindrance to a sure cure by remedies which have been used locally, is the ability of the germ to penetrate into the tissue and the many secondary cavities of the nostrils which cannot be reached by the antiseptics.



Fig. 10.—Showing method of treatment of roup birds by immersion of the head in one to two per cent. solution of potassium permanganate.

Another method of treatment which gives excellent results, especially in the earlier stages of roup, is the use of a 1 to 2 per cent. of permanganate of potash. Fowls are treated in the following manner: the nostrils are pressed together between thumb and forefinger in the direction of the beak two or three times. Pressure should also be applied between nostrils and eyes in an upward direction. This massage helps to loosen the discharge in the nostrils and eyes. The bird's head is then plunged into the solution of permanganate of potash for twenty or thirty seconds, (see Fig. 10) in fact the head may be kept under the solution as long as the bird can tolerate

it. The solution is thus distributed through the nostrils and other canals and has an astringent and slight disinfecting action. This treatment should be given twice a day and continued until all symptoms have disappeared.

If there are solid tumours in the eye-lids, they should be opened so that the skin may bleed freely. The cheesy matter should be removed, and the surrounding membrane touched with a 5 per cent. carbolic acid or silver nitrate solution, and then a cotton plug filled with some antiseptic solution, put into the cavity. The cavity has to be washed out daily with an antiseptic mixture, and a fresh cotton plug put in again to prevent the cavity from healing too quickly. We have cured chickens in this way in about a fortnight.

As all these methods of treatment demand a great deal of time and care, they cannot well be used for whole flocks, but the more valuable fowls may be treated in this manner. Farmers and poultrymen should first try the permanganate of potash method of treatment as it is the easiest to employ.

Food remedies influence roup only by strengthening the fowls and assisting nature to throw off or conquer the disease.

As in other infectious diseases, the most important thing is to prevent an outbreak, or to suppress it as soon as possible. All diseased fowls should be separated from the healthy ones; and the healthy ones should be examined daily, with a view to isolate newly affected birds. After the isolation of the diseased birds, the poultry yard should be disinfected thoroughly with a 5 per cent. solution of carbolic acid, followed by a careful white-washing of the walls, etc. Slightly diseased fowls, or any of special value, can be cured, if much care be taken. Less valuable birds, which it will not pay to treat, should be killed as soon as manifest symptoms of the disease appear, especially when the face becomes swollen. These fowls, unless the best care is taken, will remain diseased for months, or perhaps years, and give rise to fresh outbreaks whenever an unfavorable season (with much wet, cold weather) occurs.

The most effective preventive for roup is to keep fowls in good sanitary conditions—in dry, roomy yards and dry, clean, airy houses which are free from draughts and can easily be cleaned and disinfected.

