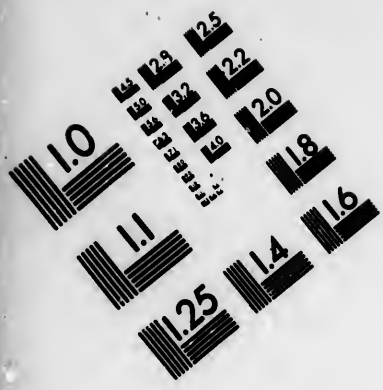

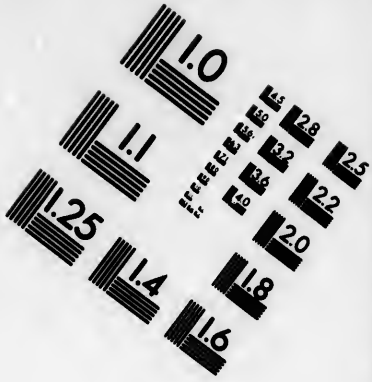

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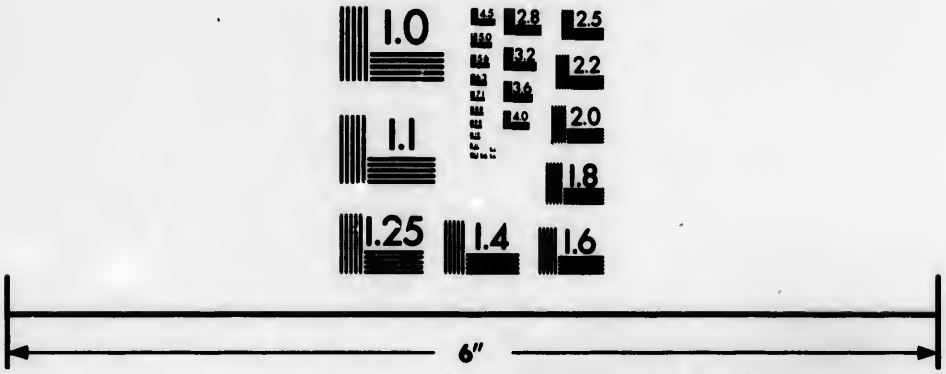

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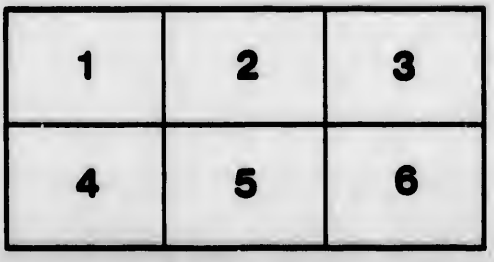

Mod

Adami, J. G.
To Professor Foster
with cordial regards from
J. G. A.

MODERN PATHOLOGY.

BY

J. G. ADAMI, M.A., M.D.,
Fellow of Jesus College, Cambridge.
Professor of Pathology in the McGill University, Montreal.

(*Reprinted from the Montreal Medical Journal, February*, 1893.)

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MODERN PATHOLOGY.*

By J. G. Adami, M.A., M.D.,
Fellow of Jesus College, Cambridge.
Professor of Pathology in the McGill University, Montreal.

Medicine at the present moment is passing through its great age of renascence. Never before in its whole history have such advances been made as are being recorded month after month in these last years of the nineteenth century, and with these great advances and their bearing it is that I wish to deal this afternoon. For they have been gained, not by chance speculation, but by purely scientific methods,—they are the results of experimental pathology—and, thanks to them, we are beginning to see our way out of that empiricism which has been the bane of our profession all these centuries, an empiricism which has made us the laughing stock of the wits and the butt of the cynics of every age.

Just in proportion as we gain an accurate series of observations so do we add to the science of medicine, so do we, in fact, establish a true Pathology. For pathology is the scientific study of disease. There still exist those who look upon the dead-house as the be-all and end-all of the pathologist, who regard the careful study of diseased tissues, of their gross and minute lesions, as forming his main function. Certainly this is a most important function, and one that, in English-speaking lands, needs yet further development. Here, in Montreal, much more advantage

* Inaugural Address delivered in the William Molson Hall, January 3rd, 1893.

might be reaped by the earnest student out of the post-mortem room. I fear that we should fall under the condemnation of that intelligent Yankee whose sweeping condemnation of the English medical schools was to the effect, "No, sir, you do not understand scientific medicine in England; you are nowhere near to it. Look at Berlin and compare: there every physician and surgeon considers that he has failed in his duty if he is not able to confirm his diagnosis by means of a post-mortem." We do not go so far as that here; we do not desire to attain to that Utopia; nevertheless we might accomplish more than is accomplished at present.

But the number of pure and simple morbid anatomists is rapidly fading into nothingness. Now at length it is generally acknowledged that inasmuch as pathology is, as its name implies, the study of disease, so is it to be entered into in the widest sense, and that the domain of the pathologist is the investigation not only of the *results* of disease, but also and equally of the *causes* and of the *course*. This is pathology at large; and now with recognition of this elementary truth that in order to advance surely a subject must be studed in all its aspects—origin, equally with progress, and equally with end—medicine has entered upon a new phase. Thus, at last, to combine one of the innumerable rich metaphors with which those of this side have enriched our common language with one of more assured antiquity, pathology is no longer a "one-horse shay," with that poor one horse behind.

If medicine is to be treated as a science it must, like all other natural sciences, be based upon experimental investigation. All the great advance of the present day is due to submitting the problems of our profession to the touchstone of experiment in place of the vague and abundant hypothesising of the past.

I know no better illustration of the truth of this contention than is afforded by the history of the events which led up to Pasteur's great discovery of the method of preventive inoculation against Anthrax, a disease the study of which has formed the starting point of all our later investigations into infectious disorders.

Anthrax is an epizoötic that has for long been recognized in

all quarters of the globe, a disease affecting the domestic animals and occasionally man himself, a disease causing a terrible mortality in the herds of sheep and cattle of districts where it has broken out. But until the sixties, like all other infectious diseases, absolutely nothing, or, not to be extreme, absolutely next to nothing, was known as to its nature, nothing could be done to eradicate it. Most held with Topsy that it "growed," the fatalists consoled themselves by declaring the disease a visitation of Providence and sat down, grimly patient, to await events.

It is true that some went as far as the theorising stage. Thus in France, in the district that may be termed the classic land of anthrax, the fertile district known as the Beauce, lying around Chartres, the farmers spoke of it as a disease of the blood. These Beauceron farmers are a curious observant race. It has been their custom to open and examine the carcases of the sheep that die. They held that the full-blooded, best nourished animals were those most easily attacked. Doubtless the natural habit of looking upon that which is lost as best had much to do with this notion of theirs. Still so it was, they held that anthrax was a "maladie du sang," and this view, translated into scientific language by Delafond, held sway for some years in France; that is to say, plethora was indicated as the main predisposing cause of the disease. The rich succulent pasturage of the Beauce region as compared with the neighbouring sterile but anthrax-free Sologne spoke in favour of this view. Indeed it became the custom when an anthrax outbreak occurred to transfer the sheep from the Beauce to the Sologne. A further argument in favour of the same was the fact that from time to time certain farms and in these certain meadow lands were specially attacked. The mortality was appalling: as many as fifty to one hundred sheep might be found dead in the morning. Now these affected meadows were apparently the most fertile, the grass was a lush dark green; but for years they were unsafe. The farmers called them sadly the "champs maudits"—the accursed fields.

The first step forward was made by a French Governmental

commission in 1852. This determined the infectious nature of the disease, showed that one and the same malady affected horse, sheep and cow, that inoculation with the blood of an animal dead of the disease induces the disease in another, and, what for our present purpose is of especial importance, showed that small animals, rabbits and guinea-pigs—animals which can be employed for purposes of research—can be inoculated and will manifest the symptoms associated with anthrax.

Next in order of time may be placed Davaine's advances upon his early observations, observations confirmed by Pollender and others, that the blood of animals suffering from anthrax contains innumerable minute and characteristic rodlets. Davaine and Rayer had first found these in 1850 and had described them very accurately. But not until Pasteur's papers in '60 and '62 upon the micro-organisms causing lactic and butyric acid fermentations could any explanation be given of their significance. If microbes be the cause of fermentation, it might be that they could also cause disease; there might be truth in the old vague fermentative theory which time after time had been brought forward to explain epidemic and other maladies, and thus Davaine was led to renew his studies upon anthrax. He found the rodlets constantly present in the blood of animals suffering from anthrax, that whenever they were present the blood was virulent, that fœtal blood from animals that had died of anthrax did not contain them and was not virulent. To Koch, however, we owe the complete proof that the bacilli are the active agents in the production of anthrax. He was the first to gain pure growths of them outside the body, and to show that the most minute quantities of such growths could cause the disease, and, again, by discovering that the bacilli formed spores, he cleared up a large array of difficulties in connection with the propagation of anthrax. These spores are little bodies—germs—formed within the bacilli; they can stand heat and cold and drying up, and can retain their vitality under conditions which are rapidly fatal to the bacilli containing them.

All this was a very great advance. We were taught that an infectious disease might be due to the entrance into the system

and propagation in the same of a minute vegetable organism. This was one great truth learned by experimental research. But still this was only a stage from which more might be learnt.

To some sufferers from toothache it brings a certain amount of consolation to be informed by the dentist that the pain is due to, say, an abscess at the root of the tooth; but even to these, as to all others, the important question is: How is that abscess formation to be brought to an end? What treatment can the dentist employ which will surely stop the pain? Now, this subject of research into the nature and prevention of disease is so young that there are still at this moment many infectious diseases and those the commonest—for instance scarlatina, measles, small-pox,—of which as yet we do not know the cause of the ache, if I may so express it, and very many others, notably tuberculosis, of which we know the cause, but have not yet arrived at the stage of operative prevention. With anthrax, however, thanks to Pasteur, we have arrived at the preventive stage.

It is in the highest degree instructive to follow the steps whereby Pasteur gradually arrived at his great discovery of preventive inoculation. Koch was unable to give anthrax to guinea-pigs and rabbits by feeding them with large quantities of spores. Pasteur, with the aid of the Beauceron farmers, solved the difficulty. He made huge growths of the anthrax bacilli, and, with these, watered certain fenced-off patches of meadow-land; a small flock of sheep was turned on to the watered patches, another small flock on to the adjacent unwatered meadow. Among the former there was a fair mortality; the latter were unaffected. It was clear, therefore, that at times the disease can be produced by the ingestion of the bacilli or their spores. When, now, Pasteur fed the animals on spore-containing bacilli, together with the thorns and substances liable to cause irritation and laceration of the mucous membrane of the intestine, the mortality became enormous. Intestinal lesions are, therefore, an important predisposing cause.

Next, Pasteur turned his attention to the earth of the

"champs maudits." He washed some of this in water, allowed the poured-off supernatant water to deposit the finer particles held in suspension, decanted off the water and heated the fine deposit in order to kill off all the ordinary microbes of the soil, leaving only the resistant spores alive ; inoculated a series of animals with the material so gained, and of these a certain number died of veritable anthrax. Thus he was enabled to show that the earth of the affected meadows contained anthrax spores. The proof was absolute. The theory of plethora fell to pieces before the results of experiment.

It is unnecessary here to describe in full how Pasteur demonstrated that the meadows had become "accursed" by the previous burial in them of animals that had died of the disease, or how years before Darwin brought out his admirable monograph upon the earthworm, Pasteur proved that it was this great fertilizer that, peculiarly frequent in the rich pastures, brings up to the surface the spores from round the carcases of the buried animals. Time forbids. I must pass on to the more direct researches of this keenest of observers into the production of immunity.

When Pasteur and Chamberland inoculated a number of cows with pure growths of anthrax they found that some died and some simply suffered from a transient malaise and survived, and, what is of special importance, that the survivors were immune to further attacks of the induced disease. And now the question arose : could the virus be so attenuated that all the cattle could be given a mild form of anthrax, and so be rendered refractory.

But here a great difficulty presented itself : the bacilli, as I have said, form resistant germs, or spores, and so long as such spores are developed, so long is there a succession of bacilli possessing a virulence equal to that of the spores from which they sprang. So long, therefore, as there are spores, so long is it impossible to gain attenuation. To gain attenuation the first step must be to prevent the development of these resistant germs. This was accomplished by keeping growths of the bacilli at a temperature so high—42-43°C.—that their development is hin-

dered and almost stopped. The longer the cultures are kept at this temperature the weaker do they become until in forty days or so they die off, and, no spores being formed, a small number of the bacilli taken any day after the eighth and grown in fresh culture fluids at blood heat, preserve for long the grade of attenuation implanted upon them. Thus a series of races of the bacilli can be gained of different degrees of virulence. In these Pasteur obtained what he wanted.

Upon May 5th, 1881, before the Agricultural Society of Melun, Pasteur inoculated 24 sheep with growths of weak, attenuated anthrax bacilli. Upon May 17th he inoculated the same 24 with his stronger second vaccine. On the 31st he inoculated all these and 24 unvaccinated sheep with the most virulent cultures of anthrax that he possessed. Within 72 hours all the unvaccinated sheep were dead from anthrax. Of those vaccinated but one died, and this one at the autopsy was found to have suffered from a serious ailment of another nature.

This was Pasteur's first attempt at preventive inoculation against anthrax upon any considerable scale, and, whereas, in the affected regions of France the mortality from anthrax had been, among sheep, nine per cent., and, among oxen, seven per cent., now it is below one per cent. In the first year alone of general employment of the method, among the eighty thousand or so sheep inoculated, the mortality would, under the old conditions, have been over seven thousand; it was reduced to a little over five huudred. Six thousand five hundred animals were thus saved to France in that year alone. As a consequence of the process the price of land in the affected districts has increased in value, for now the "champs maudits" can be freely used; the most important insurance companies decline to insure animals upon farms where the vaccination is not practised, and indeed themselves undertake the preventive inoculation of animals.

I have here given, at what may be held to be too great a length for this occasion, the account of the advances that have been made in our knowledge of one infective disease. I have done so purposely, for I wish you to realize how these advances have been accomplished not by mere superficial observation, or

by lucky haphazardings, but by a sequence of ably-conceived researches, the one leading onwards rationally to the other until, step by step, not only the primary cause, but also the means of prevention of a terrible disease has been satisfactorily attained.

This is but one of the triumphs of modern medicine, and now I doubt whether I can better employ the next few minutes than by bringing before you, in rapid review, the more prominent and telling achievements of recent pathology. I doubt whether I can better bring home to you the vital importance of my subject than by such a review, or can better "seize the day" than by so impressing you with the magnitude of the progress that has of late been made that I may stir up in you the earnest desire to see Montreal and Canada participating worthily in this great new birth of medicine.

Thanks to experiment, we have gained a knowledge during the last twenty years, and more especially during the last twelve years, of the bacteria associated with a host of the diseases affecting man and the lower animals; of the microbes causing suppuration and erysipelas, pneumonia, typhoid, diphtheria, influenza, tuberculosis, leprosy, glanders, relapsing fever, tetanus and malignant œdema, of microbes not bacteria associated with malaria, actino-mycosis, ringworm and favus. These and others are the infectious agents in man alone. If we take into account the lower animals also, I see that a recent able and laborious worker, Dr. Sternberg, gives a table of no less than one hundred and fifty-eight definitely recognized pathogenic micro-organisms, and the number, like that of the minor planets, is being increased month by month. It may alarm sundry here present to learn that there exist so many infectious diseases under the sun. I must ask you to take it for granted that there are so many, and, it may be, as many more, for I will not seek to entertain you by reading out Dr. Sternberg's list, together with the names of the investigators who have studied each of these 158 maladies.

With not a few diseases has the stage been reached of satisfactory preventive inoculation in the laboratory, the smaller mammals being employed. Pneumonia and typhoid may be cited as good examples. Tuberculosis and diphtheria are

doubtful examples. With these our success so far must, for practical purposes, be considered incomplete. Still, in these cases, the prospect fills us with hope.

With a few diseases already great success has been attained. First in place, as it was first in time, I may mention fowl cholera —a malady common in France, where at times it decimated the poultry yards. Pasteur was able to isolate the bacillus causing this, to grow it, to attenuate it, with the attenuated virus to give a mild form of the disease to the fowls, and thus to protect them from contracting the fatal form. Thereby the disease has been overcome, if not eradicated, in various parts of France.

Another malady, very fatal in certain districts, affecting especially cattle, and known as "black-leg," "quarter evil" or "symptomatic anthrax" has been most successfully combatted by preventive inoculation, the method suggested by Arloing, Cornevin and Thomas, and elaborated further by Kitt, being extensively employed in Switzerland and lower Austria. Here the experience gained from years of study of the disease has shown that a different method of attenuating the microbe is best employed. The flesh of an affected animal is taken, is dried and powdered and subjected to heat. By this means the spores of the contained microbes are attenuated, and a two-fold inoculation of the powdered muscle under the skin induces a mild disease and is protective. There is but one disadvantage in the method. Every endeavour has so far not succeeded in rendering it absolutely safe. After a series of, it may be, ten thousand successful vaccinations, suddenly, out of a batch of ten animals inoculated, eight may die as an immediate consequence of the treatment. The loss may thus fall terribly upon a single owner. This, however, has not prevented the Bernese farmers from employing the method, for they freely recognize its immense economic value to themselves. To obviate the difficulty and minimise the possible individual loss they have constituted themselves into a syndicate, and any loss is distributed all over the members of the same.

So, too, the disease known here as "swine erysipelas," in France as "rouget," in which the mortality is very high, often

twenty-five per cent., at times sixty per cent. and over, has been hindered in its spread by the researches of Pasteur, Roux, Chamberland and Thuillier. These observers found that if they injected a pure culture of the minute bacillus causing this disease into a pigeon, and passed the disease from pigeon to pigeon, the disease became more and more severe. The microbe gained in virulence. If, on the other hand, they made a similar series of passages through the rabbit, the microbe, while becoming more fatal to the rabbit, became less and less harmful to the pig. So that vaccines have been prepared with which vaccination against the malady is extensively practiced in France, Germany and Switzerland.

Here, then, we have a small series of diseases in which protective inoculation or vaccination has already been of enormous economic benefit. Thousands of sheep, of cattle, of swine, and of fowls are yearly being saved by these protective means. What, now, had been done for man himself? Well, man is an animal that it is difficult to treat satisfactorily. Having a will of his own and ideas of his own, the latter very often very wild, it is difficult to compel every individual in a district or country to comform to what the majority is assured for common good. We know this only too well in connection with the one form of vaccination that is already practised. That being so we can reduce the ravages of, but cannot hope to stamp out, a given disease. When further there is added the fact that a certain proportion of individuals are peculiarly susceptible to any given disease, and thus, that a certain number of individuals are liable to succumb in direct consequence of inoculation with an attenuated virus, a further difficulty is added. And, above all, there is the terrible responsibility attached to the initial investigation. We are playing with edged tools with a vengeance, and where the inoculation of a given virus will lead to one of two alternatives, and one of these two alternatives is the death of a fellow human being, then even the boldest may well shrink from initiating a procedure of this nature, however much he feels confident that the procedure is for the welfare of his race.

But, despite all this, the pathologist has succeeded in certain

cases. In one that can scarcely be considered as coming under the head of modern pathology (I refer to the true Jennerian vaccination), the inoculation, as you know, has already been carried on for nearly a century, though it is only now that the medical world is becoming convinced that what we produce in vaccination is a very mild attenuated small-pox, the virus being greatly modified by passage through the cow.

In the other cases we have had to depend for success either upon the fact that there is a very long period of incubation, during which preventive measures may be taken, or upon a modification of the procedure. A very long series of investigations by a great number of observers has shown us that the pathogenic bacteria in their growth produce certain toxic substances, and that to the poisons produced by them are due the symptoms of the disease. To give one example : By filtering the bacilli from the fluid in which they have been grown, Roux and Yersin have succeeded in isolating from cultures of the bacillus, associated with diphtheria, a substance which, inoculated into dogs, will in due time produce the same transient paralyses of the muscles of the eye, the soft palate, and the body generally, which in the human being so frequently manifest themselves in consequence of this disease. But, what is more, it has been found that in some cases by injecting the culture fluids, or substances gained from such fluids into animals, immunity can be produced, so that, if now large quantities of the microbes of the disease be injected the animals so treated remain refractory and show no symptom. It was two American observers (Salmon and Smith) who first in 1886 demonstrated this fact in connection with hog cholera. Since then the same has been proved for quite a host of diseases.

Again, a series of observations—started originally in connection with what might be thought to be the quite academic and unpractical subject of the exact nature of immunity—has led us to discover that certain tissues of the body, and certain cells of the blood itself, develop substances (defensive proteids or antitoxines) which antagonize the poisons produced by the pathogenic microbes, substances which can be shown to be

present in the serum, or fluid part of the blood. I should like to describe to you the latest demonstration of this fact given by my friends, Dr. Kanthack and Mr. Hardy—a demonstration as beautiful and ingenious as it is convincing, but to do so would lead me off my main path. So we arrive at this: if we take the blood serum of an animal that has been rendered immune against a given disease and inject it, or the antitoxine that it contains, into another but susceptible animal, that animal is rendered refractory to the disease. This principal has been employed by Tizzoni, of Bologna, to cure tetanus or lockjaw in man. That awful malady, as you may know, is not common, and opportunities do not often present themselves in which a supply of tetanus antitoxine is at hand to inject into the sufferer from lockjaw; nevertheless, during the last few months several cases have been recorded in which the disease has been cured and life saved by this means.

This brings me to the consideration of a yet more dread malady, one that it is difficult for me to classify, in that we have not as yet discovered the microbe which is its prime cause, and cannot absolutely declare that the preventive method devised by Pasteur and his associates acts in consequence of the attenuation of the living virus, or in consequence of the introduction into the system of the products of the growth of that virus, or, again, through the medium of antitoxines contained in the emulsified tissues that are introduced subcutaneously. Very possibly there is a conjunction of all these three. I refer to that most awful of all diseases—Rabies, or, as it is most commonly termed, Hydrophobia—most awful, not only in the bodily agony of the attack, but in the mental agony of the suspense attendant upon the long and very variable period that may elapse between the bite that induces the disease and the manifestation of the same.

The account of how Pasteur and his lieutenants advanced step by step towards the solution of this most difficult problem of the prevention of rabies of those already bitten, forms, perhaps, the most entrancing page in the whole history of modern medicine. But here I can only tell you that they discovered a

virus of constant strength in the spinal cord of the rabbit after the disease had been passed with due precaution through a long series of rabbits and the virus had been gradually intensified, that having gained this fixed virus they modify it by the action of moderate heat and of air, and that into the person that has been bitten is made a series of daily subcutaneous injections, beginning with an emulsion of rabbit's spinal cord that has been dried for fourteen days so as to be harmless, and ending with an emulsion of a portion of cord that has been dried three, or it may be only two, days, which is in consequence of extreme potency.

What have been the results of this treatment?

Whereas the most reliable statistics for the last twenty or thirty years give a mortality of more than 12 per cent. in those bitten by rabid animals, amongst the thousands that have undergone Pasteur's treatment the death rate is considerably under one per cent. At Paris alone over ten thousand patients have been inoculated since 1885, and over a score of "anti-rabic" institutes have been established in various parts of the world from Damascus to Rio.

It may be—and has been—objected that it is not just to argue from the total number of those treated, inasmuch as very frequently the evidence is of the slightest that the animal inflicting the bite suffered from rabies, and that too often the dog it is that dies—dies immediately without a care being taken to study his symptoms, while the man in his panic rushes off to Paris or elsewhere, and if there be any reasonable suspicion as to the dog's sanity he must perforce be allowed to undergo inoculation and swell the list of patients. In this connection, however, it is noteworthy that in the year 1887, for example, in Paris alone 350 persons were bitten by rabid animals; 306 of these were inoculated by M. Pasteur's method's, and 3 died: mortality =0.97 per cent. 44 neglected to present themselves at the Institute and trusted to luck; of these 7 died: mortality =15.9 per cent. These results, I may add, were gleaned, not for the benefit of the Institute Pasteur, but for the Parisian Prefect of Police. But I will give you a yet more convincing series of statistics.

From 1886 to 1890 inclusive 1757 patients presented themselves for treatment at the Institut Pasteur at Paris, in which cases it was absolutely certain that the animal that had caused the bite was rabid, inasmuch as either portions of the brain of such animal inoculated into another had produced rabies, or some person or animal bitten at the same time had succumbed to the disease. Of these 1757 patients but 18 have died, giving a mortality of only 1.02 per cent.

Of all bites, the most dangerous are those upon the face and head. In France, from 1862 to 1872 (that is, long before Pasteur began to study the subject), fifty cases of this nature were collected and recorded by the Comité d'Hygiene. Of these fifty, forty-four resulted in death. And in general it would seem that the mortality from such bites is more than 80 per cent. The records of the Institut Pasteur at Paris show that from 1886 to 1889 inclusive, among the cases in which the rabid condition of the attacking animal was satisfactorily determined, 593 patients presented themselves for treatment after bites upon the head. Of these, instead of more than 450 succumbing to the disease, only 14 died. Instead of a mortality of 80 per cent. there was one of only 2.36 per cent.

It is unnecessary, I think, to say more upon this subject (for those figures are themselves sufficiently eloquent) save to notice the latest development in this relationship. Only very lately Tizzoni and Schwartz, following successfully upon the studies of the former in connection with tetanus, have shown that rabies can be prevented, and indeed stopped in mid-career, by injections of the blood serum of an animal that has been rendered refractory to the disease. We are waiting to learn how far such treatment will be successful with human patients.

I have now given you the leading cases in which research has led to the discovery of methods directly preventing the onset of infectious or contagious diseases; and had experimental investigation but led to these results and to none other, I think that you would all agree that modern pathology had accomplished sufficient to earn the gratitude of mankind.

This, however, is but a small portion of the good work accom-

plished. A large portion is to be found in the enormous advances that have been made in the indirect prevention of infection. The knowledge we now possess that infection is due to the presence of microbes has revolutionized hygiene.

Let me take but one example—and that a disease which in temperate climes swells the death roll to a larger extent than does any other. I mean Tuberculosis in its various manifestations—as phthisis or consumption, tubercular peritonitis, tubercular bone disease, lupus, and so on. Until 1883 the medical world was still doubtful as to the infectious nature of the disease, and so long as it was doubtful, so long was it impossible to do anything to limit its spread; from the moment Koch's great discovery of the bacillus associated with the disease was confirmed and gained acceptance, from that moment the controversy was set at rest.

We know now that the phthisical patient is a possible centre for the infection of others, that the sputum contains the living germs, that these germs are capable of resisting exposure for long periods, and may, if inhaled, set up the phthisical process in the lungs of others.

We know, in fact, that it is criminal not to take strict hygienic precautions in connection with phthisical patients, that the discharge from the lungs must be vigorously destroyed by appropriate means, that handkerchiefs and linen must be thoroughly disinfected, and the patient's room be kept well-ventilated and sunny, for sun and air are the great germicides.

Again, bacteriological observation has amply demonstrated that cows not infrequently suffer from a tubercular disease of the udder, and has proved fully the relationship between such tuberculosis in the cow and the tubercular inflammation of the bowels which attacks young children brought up on cow's milk. The practical deductions to be drawn from this fact are that, where possible, it is the duty of parents to determine that the cows from which is drawn the milk supply of young children are in a sound state, and where this is not possible, it is imperative that the milk should be rendered sterile by cautious scalding.

What is yet of more urgent necessity is that the State should

stamp out tuberculosis in cattle—for now-a-days it is within the power of duly qualified inspectors to recognise tuberculosis in animals. When Koch elaborated tuberculin, and when, under political pressure, he made a mistake of such magnitude as it is only given to a great man to make—as old Chaucer says,

> "For whan a man hath ouergreet a wit
> Full oft him happeth to misusen it,"—

he was very far from working in vain. Leaving out of account the impetus that his researches have given to bacteriological science, his tuberculin has proved itself to be of diagnostic value, so that, injected into man or the lower animals, it indicates the presence or absence of tubercular lesions according as to whether it induces or does not induce high fever. Thus it is a comparatively simple matter to determine the presence of tuberculosis wherever there is doubt. It is for the welfare of the community that suspected animals be isolated from their fellows and prevented from being foci of contamination; and where reinocula tion with tuberculin again leads to fever, there the cattle should be sacrificed.

It is, however, one thing to preach to those in authority upon this earth, another to get them to follow the advice of the preacher. In this matter the hygienist must, I fear, stand in the market place and pipe, without setting agog the feet of the rulers of the people. Tuberculosis is so widely diffused among cattle, and affects so particularly the most highly bred and delicate, that the commercial value of the cattle which ought to be destroyed is at present held to be a complete bar to any general action. I will say nothing as to the relative value of man and brute——and the farmer's vote. Perhaps some day this will be more evident than it is now. Nor would I thought to be taking to task the Government of this country, for Canada in this particular respect is neither before nor after other civilized communities. I only say this much in the hope that Canada, whose prosperity depends so greatly upon her four-footed possessions, and whose system of cattle inspection is so admirable, will in this matter of tuberculosis lead the van.

Only within the year that has just ended has a similar means

of diagnosis been determined in connection with another disease —a disease so fatal when it attacks man that it has already caused the death of more than half a dozen bacteriologists engaged in studying it—and the last death that I have seen recorded is that of the first to successfully work out the means of early diagnosis, a young Russian veterinary surgeon, Dr. Kalning. I refer to glanders, which at the present time is causing great ravages in various parts of Europe, but which, I believe, is not widely spread among the horses in this country, although it does exist here. Following upon Kalning, observers in Germany and France have confirmed the fact that the existence of this disease in the horse can be determined by the injection into suspected horses of sterilized glycerinated extracts obtained from pure cultures of the bacillus of glanders. Glanders in many respects resembles tuberculosis, and this fluid "mallein," like tuberculin, causes high fever in the affected animals whereby a diagnosis can be made.

Lastly, in this connection, it is impossible for me to pass over the most beneficial of all the advances that have been made through pathological research—an advance that will ever be associated with the name of our great countryman, Sir Joseph Lister. It was Lister who first proved that suppuration and foul conditions of wounds was due to the presence in these wounds of micro-organisms, and who showed that suppuration might be minimised and completely prevented by the employment of methods which prevent the access of germs to the wounded surface. This treatment has wrought a revolution in surgery. Operations are now performed securely and deliberately, which, years ago, would have been held to lead to almost certain death. And whereas erysipelas and hospital gangrene were the bane of the surgical wards, and puerperal fever ran like wildfire through the lying-in wards or attacked every woman whose accouchement was attended by some one unfortunate practitioner, and caused a terrible death-roll, now erysipelas never spreads in any well regulated hospital, hospital gangrene is unknown, and puerperal fever condemns utterly the midwife and doctor in whose practice it occurs, while it is practi-

cally banished from the hospital. To what perfection antiseptic treatment may be brought is shown by the fact that during one winter suppuration occurred but three times, as a complication of operations, at the Johns Hopkins Hospital in Baltimore. In olden times it would have been well had three operation wounds healed *without* suppuration in any hospital of the same size. Lister, by setting the example of antiseptic and aseptic treatment, has saved more lives than have been destroyed in all the wars of this century.

I have dwelt so long upon the good work done by experimental pathology in hindering the ravages of the infectious diseases, because it is in relation to these that pathology has of late gained its greatest successes, and because their incidence affects all, so that in discussing them I am the more likely to appeal to all here present. I need not say, however, that there are other forms of disease not directly due to bacterial invasion (indeed many are wholly unconnected with such), and here, also, modern pathology is throwing a flood of light upon their causation and their rational treatment. Let me instance the large class of diseases of the brain and spinal cord. In these, thanks to the researches of Hitzig, Fritsch, Ferrier, and numerous others upon the dog and monkey, we have learnt that there are areas of the surface or cortex of the brain which are intimately connected with the movements of different sets of muscles of the body and limbs, with speech, hearing, sight, and so on. We have learnt also that the nerves connected with these "centres" have definite paths through the brain and spinal cord, and thus, now-a-days, it is very often possible to determine from the symptoms displayed—the tremors, the paralyses, the disturbances of speech, or sight, or hearing—the portion of the brain or spinal cord which is diseased. It is, moreover, possible in many cases to cut down upon the region of disturbance, and, by removing the tumour or abscess pressing upon the brain substance, to save the patient from imminent death. It has been objected that this same knowledge could have been learnt by post-mortem observations without experiment upon animals, but granting, what I cannot honestly admit, that it could, the question is, when should

we have arrived at our present knowledge? Not for years and years. It was not until experimental research was made upon the functions of the brain and spinal cord that any sure knowledge was gained of those functions. And certain it is that our great English operators upon the brain and spinal cord, men like Macewen and Horsley, owe the knowledge they possess of the localisation of nerve centres to the researches of Hitzig and Ferrier.

But, ladies and gentlemen, I might continue far into the night recounting the triumphs and prospective triumphs of the modern pathology. I should like, for instance, to tell you how experiments of a purely academic nature into the functions of the sympathetic system have thrown a flood of light upon the symptomatology of that curious disturbance known as Graves' disease; I should like to tell you how, step by step, investigators like Horsley have worked out the relationship between disorders of the thyroid gland and that remarkable malady described first by Ord and known as myxœdema, until only recently Dr. Murray of Newcastle has discovered that cure may be brought about by injections of the juice of this gland taken from the sheep. But were I to continue, I should, I fear, thoroughly exhaust your patience. No matter how eloquent facts may be—and I have striven throughout to let the facts speak for themselves—there comes a period of mental repletion. I have already given you a sufficiency of facts in this brief review for you to judge of the greatness of my subject, of its high aims, of its noble achievements.

It may be that there are some here present who, through the silence of our profession when attacked by agitators, through ignorance of the facts, and through pleasant cultured habits of life and absence of contact with the huge mass of human suffering, have, until now, in the words of a friend of mine, permitted the philozoic sentiment within them to overpower the philanthropic, and who, thus far, have regarded vivisection and animal research as utterly degrading, if not, in the words of a gentle English divine, as "positively hellish." I ask such, if any there be, to seriously reconsider their position. All the progress that I have

described to you has been based upon animal research. Many of the advances made have been for the immediate benefit of the lower animals. Surely no one would venture to contend soberly that Pasteur was brutal and deserving of denunciation when, for the ultimate saving of innumerable thousands of sheep, he sacrificed a few score. I would say in all reverence, "How much, then, is a man of more value than a sheep!" Surely we act rightly if in the hope of saving men's lives, of adding to the health and well-being of our fellows, we, taking all care that they suffer a minimum of pain, employ the lower animals. Attack, I say, other painful practices in connection with the lower animals that are performed for our advantage and enjoyment. Wage a crusade against pigeon-shooting, against fishing and fox-hunting; cease maiming cattle, horses and fowls for pecuniary benefit, for comfort, or for purposes of food, and then, and only then, break out against those whose aims are higher and nobler. Thank God, our profession stands above every other in its reputation for humane feeling, and our profession unanimously supports those of its members who devote their lives to research. Perhaps it will be retorted that I am wrong in employing the term "unanimously," for that great physiologist and man of science of the antivivisectors, Mr. Lawson Tait, is dead against us. With all due acknowledgment of Lawson Tait's genius and marvellous power as an operative surgeon, I contend that he is no more a man of science, in the true acceptation of the term, than a skilled carpenter is, in ordinary parlance, a professor of applied mechanics. The very fact that the antivivisectionists fall back upon him as their medical mainstay proves my contention.

It may be also that among my colleagues there are those who would fain have me urge the claims of pure science apart from practical results. I own the rectitude of this plea. Science is not to be pursued for immediate results. The Professor of Chemistry—Pasteur—little thought that in beginning his studies upon the crystallisation of tartaric acid he was starting upon the path that would revolutionize medicine and make him the greatest benefactor that France and the world at large has ever possessed. The insignificant parish doctor in Posen—Koch—

had no idea that his attempts to gain cultures of anthrax bacilli from the cattle that died in his district would result in his becoming the great auxiliary in this revolution. And so it is always—science, to be successfully pursued, must be pursued for itself. To-day, however, I think I do rightly in showing the great results of such a pursuit, and in proving in a way appropriate to the end of the nineteenth century the truth of the old Arabian proverb—"The ink of science is more precious than the blood of the martyrs."

This, however, ladies and gentlemen, is not my ultimate moral. I have throughout this lecture endeavoured to keep that in the background, though to do so has been difficult,—and just as the Irishman in dock, when asked by the judge whether he had anything to say before sentence was pronounced upon him, replied, "Sure, my lord, and I leave it to your conscience," so I, too, would much prefer to leave this moral to the conscience of my audience. We who have the cure of bodies are infinitely more diffident than our brethren of the cure of souls; the miserable condition of the building in which our Faculty is housed—the Faculty that has made McGill what you now know it to be—is, I think, a strong argument in proof of our diffidence.

You will have learnt from the cases that I have put before you that human pathology and human medicine are based upon comparative pathology, that it has been through study of disease in the lower animals that man has thus greatly benefited. And this study of the disease of animals along with that of man ought especially to be pursued in a country like this, a country that depends so largely upon its cattle for its prosperity. Surely Canada ought not to be behind in the beneficent race that is now being run between the civilized nations to discover the prevention and cure of disease. Surely the time has come that due opportunity should be given to the student to study worthily a subject so rich in promise, and fraught with such actual and prospective benefit to our race. And here in this the leading medical school of the country, with its associated veterinary faculty, it is that the start should be made.