prevent the public interest clashing in any way with private professional work.

There is only one other point to which I beg leave to refer, and that is, the abolition of the system of apprenticeship in the medical profession. This question was well discussed, you will remember, at a Branch meeting held at Matlock Bath some years ago; and I then advocated, as I do now, a return to a modified apprenticeship of about two years. Any medical practitioner who has been in the habit of employing assistants in his work, will bear me out in the truth of what I now say, that those men are the most useful, in the country at least (I had almost said the only useful men), who have spent some time in a surgery under experienced eyes, and are practically conversant with the details of general practice.

In conclusion, gentlemen, I think you will admit that we belong to a profession which is largely unselfish, and which is doing an amount of gratuitous work amongst the poor (and also, I fear, amongst those who can afford to pay for it), the benefit of which cannot be estimated. The members of it, often regardless of remuneration, work hard by night and by day, and for what? Wealth and position? Most emphatically, no. These rewards fall to the lot of but few of our *confrères*; witness the records of the Medical Benevolent Fund and the Medical Benevolent College, two institutions which I recommend most strongly to your support. Medical men are placed daily and hourly in positions of imminent peril. A cut at a *post-mortem* examination, or the contraction of germs of disease, may either kill them outright, or prostrate them for weeks and months upon a sick-bed, and in the end imperil their usefulness. The late lamented Dr. Anstie, a man whom the profession could ill afford to lose, died, you will remember, six days after an injury at a *post-mortem* examination. Notwithstanding these dangers and perils, which are always before him, the doctor never hesitates, but, like a brave and gallant soldier as he is, he goes boldly to the front, and wages incessant war against those enemies of our race, disease and death.

"A wise physician, skilled our wounds to heal,
Is more than armies to the public weal."

The services of the profession of medicine are not, I think, recognised as they ought to be. There are scarcely half a dozen members of it at present occupying seats in the House of Commons, and not a single member has as yet found his way into the House of Lords. Would that august assembly, think you, lose one jot or one tittle of its dignity by adding to its ranks a Paget, or a Jenner?

No, gentlemen, we cannot, like the clergyman, however meritorious our services may have been, whether in a public or private capacity, or whatever help we may have given to the progress of our art, see, even in a far-off view, a place on the episcopal bench, or anything corresponding to it, or a seat in the House of Lords, as a reward for our work; neither can we, like the lawyer, behold—it may be, looming in the far distance—the wooll sack as the "ultima Thule" of our ambition. No, these rewards are not for us; these honours descend not to the votaries of physic; but other rewards and other honours we can and do obtain; not the least of which, I take it, are the pleasure and delight which arise in every well-regulated mind from the conscious knowledge of work well done, of labour honestly performed; and there is not, I believe, a single medical practitioner, whatever may be his position, whether he be practising his profession in any of the great centres of population, in the which he may have achieved a far and wide fame—a fame extending far beyond the area of the town or even the county in which he lives—or whether he be pursuing his more arduous and certainly not less responsible work in a much more humble sphere, perhaps in a remote country village, having secured, by dint of his own industry, skill, and perseverance, a reputation equally sound, but limited and confined within a very narrow circle—I say, there is not a single practitioner who may not derive pleasure, and comfort, and satisfaction—a satisfaction far greater than that arising at any time from the acquisition of either gold or place—from a knowledge of the fact that he has endeavoured, and is endeavouring, through evil report and through good report (however much he may have fallen short of his own hopes, wishes, and aspirations in this respect), faithfully, honestly, and conscientiously to fulfil the duties and the obligations which belong to the responsible position and station in life in which Almighty God has been pleased to place him.

BEQUESTS.—The late Mr. James Carlisle, J.P., of Belfast, among other bequests, has left £500 to the Belfast Charitable Society; £500 to the Belfast Royal Hospital; £200 to the Belfast Hospital for Sick Children; and £200 to the Belfast Ophthalmic Hospital.

AN ADDRESS ON THE GERM THEORY OF DISEASE.

Delivered at the Annual Meeting of the East Anglian Branch.

By JOHN LOWE, M.D.,

Consulting Surgeon to the West Norfolk and Lynn Hospital; President of the Branch.

GENTLEMEN,—In occupying the honourable position which I do to-day, through your good-will and suzerainty, my first and most pleasing duty is to offer you on my own behalf, and on that of my professional brethren in this town, a most cordial and hearty welcome to the "ancient and loyal borough" of King's Lynn, and to assure you that we value highly the honour you do us in coming amongst us. We do not doubt that the annual interchange of kindly feeling, promoted by these meetings, tends greatly to keep alive in our midst that healthy professional life and zeal which our great Association has done so much to foster. We have one advantage over some other societies and congresses, that the topics brought under our notice are never old and effete; there is always something new in theory or fact to add interest to or throw fresh light on subjects which seem to have become exhausted. Each busy practitioner, whose arduous duties leave no time for original investigation, has yet the opportunity of gleanings important items of knowledge and practical detail to add to the general fund; while we have the advantage also of more extended observation from some whose lives are given to more deliberate study and research. The names of those who have consented to come and read papers to-day will prove that our time will be usefully employed. It is now fifteen years since the first visit of our Association to Lynn, under the presidency of my late respected colleague, Dr. Hawkins. Many have passed from among us since that time; but I rejoice to see present to-day, and to be able to welcome, some who were here on that occasion also. I would venture to express a hope that so long a period may not be allowed to elapse before our next meeting within these walls.

At our last annual meeting, you had the advantage of hearing, from our ex-President, Dr. Crowfoot, a most able and instructive address on the Germ-Theory of Disease, in which you had presented to you an admirable *résumé* (since published) of the present aspect of a theory which has had, and will have in the future, an influence on medical thought and medical treatment which it is impossible yet to measure justly, which in many respects has revolutionised both practice and theory in some forms of disease, and which, in its startling revelations and important bearings on the health of the community, is full of interest to us all.

In thinking over a subject on which to address you to-day, it seemed to me that some points of practical utility might be elicited from the same topic in its relation to surgery. I would thus avoid, as far as possible, travelling over the same ground so well worked by Dr. Crowfoot. Though it is so wide and comprehensive a subject, and familiar as it must be to many amongst you, there are certain features in it which seem to require greater prominence than they have generally received, and from a consideration of which I think we may possibly derive some practical advantage, though there may be nothing novel or original in what I have to bring before your notice.

The germ-theory of disease naturally gave rise to the antiseptic theory of treatment, and to the brilliant results which the experiments of Mr. Lister, and his practice, with that of his followers, have brought about, and which have, in the last twenty years, worked so striking a change in surgery. The two theories are so closely connected, that it would seem, at first sight, if one be true, the other must be true also; and no doubt this is so in fact, though it is possible for the antiseptic treatment to show points of failure, or to be proved in a measure unnecessary, without invalidating the germ-theory of disease.

But if we arrive at a point at which it is fully proved that all fermentation is the result of germs; that all septic poison in wounds is produced by germs; that within the body there is no sepsis, and without the body no putrefaction, where germs are excluded; and, finally, that antiseptic treatment prevents putrefaction and septic poisoning,—it would not be unreasonable to conclude that both

theories were absolutely true, or rather it would be the height of unreason to come to any other conclusion.

If, on the other hand, it can be shown that germs may exist in wounds without producing evil, and that the antiseptic treatment may be so modified that it is practically abolished, then its opponents have apparent grounds for repudiating the theory in a measure, and for denying its entire validity.

Now, this is just what is happening at the present time. It has been shown that germs may and do exist in wounds without causing sepsis; and splendid results have been obtained in the most formidable surgical operations, where sepsis was formerly the rule rather than the exception, without having recourse to those details which have been insisted on by Professor Lister and his followers as the *sine quâ non* of antiseptic treatment. You will remember that the late Professor von Bruns, after discarding the use of spray, found his cases recover as well under the use of carbolic irrigation; and that he had no deaths from pyæmia or septicæmia.

In ovarian operations, Drs. Keith and Bantock have alleged that the carbolic acid was actually injurious, and have also relinquished the spray as useless and troublesome; and, in the later operations, the mortality has been under 3 per cent.

Mr. Lawson Tait, an uncompromising opponent of the antiseptic treatment, denounces it in most emphatic language, and asserts that, without it, his mortality is not more than 3½ per cent. in cases of ovarian operations. He says: "I have already said enough of the so-called antiseptic system of Lister, to be able to say that it has finally been dismissed from this department of surgery, as having done far more harm than good. I venture to predict a similar fate will meet it everywhere else." (*Medical Times and Gazette*, November 5th, 1881.)

It is probable that the large majority of operations do not carry out the Listerian method in its integrity, and that, in by far the greater number of cases, the degree of antiseptic treatment is, compared with that of Lister, merely nominal; and even Mr. Lister himself now regards the use of spray as of secondary importance.

Then there is the mode of treatment, without antiseptics, by what is called the "dry method," in which no antiseptic treatment is employed, which yields excellent results in giving union by first intention, without any trace of suppuration. In all these cases, there must be a free admission of germs which do not prove hurtful in preventing an aseptic result; and, if this be so, it is not surprising that there should be a tendency to revolt against the exactions of a precise, tedious, and costly method. We have, finally, the statement of Mikulicz: "The original theory on which Lister's treatment of wounds is founded is not absolutely correct. Two remarkable facts stand to controvert this theory: 1. Viable elements of coccobacteria are found beneath carbolic dressings, even in cases which run a faultless course. 2. The Listerian precautions do not by any means suffice to keep out of wounds, or to destroy, the germs, as has been shown by Nägeli and Büchner." (*Medical Times and Gazette*, March 5th, 1881.)

It may not be without advantage, therefore, if I crave your attention and indulgence, while I endeavour to put before you some points, in connection with this subject, which seem to me capable of yielding practical fruit in the explanation of apparent discrepancies. For it must be to us all a most important question, whether facts of this nature assail the germ-theory with any force, or whether there are other modes of accounting for the success of two different lines of treatment; and the question is important for this reason, if for no other, that, if all sepsis be preventable by antiseptic treatment, we are greatly culpable if we allow lives to be sacrificed by our neglect in carrying out the proper method in its entirety.

The theory of fermentation, as at present received, is, as you know, that in all fermentive processes, with the exception of a few which are termed chemical ferments, germs are always present as the originating and maintaining cause; and that, without them, no such change is begun. I need not remind you that these points have been fully established by the experiments of Pasteur, Lister, Tyndale, and others; and that they are as absolutely true as any other scientific fact. The most important agencies produced by them are of a putrefactive character; in wounds, those germs which produce septic poison are regarded as common forms, having more or less identity of action; in disease, they are thought to have a distinct specific character for each form of malady.

As there are important differences in function in the several varieties of common or "surgical" germs, I would ask your attention for a few moments to some of the leading peculiarities which characterise them—a consideration of which may assist materially in the inquiry we have undertaken.

The germ-forms which act as ferments are represented by three types—viz., the yeast-cell, the bacterium form, and the micrococcus. Other intermediate forms exist, which are known as bacilli of various kinds, but they are all referable to one or other of these groups. In the familiar form of yeast the germs are spherical. During the process of growth, they multiply with great rapidity by germination or budding, setting up at the same time a chemical change in the saccharine fluid. It is not, as yet, precisely known how this change is effected: whether, as some suppose, by the secretion of a ferment, or whether by the abstraction of certain chemical elements, thus allowing a rearrangement of the particles. There is no evidence of a secreting power, though some recent observations (such as those of Hoppe and Traube) seem to render this possible. But it is certain that the germs abstract oxygen from the fluids, and, looking at the enormous increase in their bulk, it is evident that they also largely abstract carbon from the sugar, and this readily explains the production of alcohol and carbonic acid. During active growth, the nuclei may be seen moving rapidly within the cells. The growth of the germ-cells is found to be checked very quickly by variations of temperature, and by the addition of various chemical substances—such as acids, alkalies, spirit, and especially by excess of oxygen; and also by excess of sugar, as is seen in the resistance offered to fermentation by saturated solutions. This kind of resistance seems to negative the idea of there being a secreting power in the germ; and it clearly points to a principle which is of vast practical value in explaining the mode in which germs become inert in the tissues, and renders clear the part which dilution of fluids plays in favouring molecular mobility and chemical change.

The yeast-cell shows a certain power of selection in the matter of food, so that, when it has been grown in one kind of medium, it acts with difficulty in another. It becomes educated, as it were, to its special work.

If we trace the life-history of the cell, we see that there is no such thing as a distinct species, but that several, if not many, species are combined under one form; and, though these are large bodies, compared to morbid germs, no microscopist has yet ventured to assert that he could distinguish one species from another, in the way that has been done with bacteria and micrococci. It is only when they are allowed to develop and fructify aërially, that the specific distinctions become manifest.

When yeast becomes mature, the cells are filled with nuclei, and if it be dried the cell-walls disappear, and nothing remains but a mass of coccobacteria, the original nuclei. The substance, when dried, is hard and horny, and will keep for a long time in this form, and portions, if it be grown in wort, will at once redevelop into yeast. Even after seven years, I have found the germs active and capable of thus redeveloping. If the recent yeast-cell be dried on a microscopic slide, it does not shrivel, but, after losing its water, assumes an oval form exactly like bacterium termo; a similar form is assumed when it is placed in acid or in alkaline solutions.

Yeast plays no part in surgical affections, being only formed in the human body in certain affections of the stomach. It is worthy of note that it exists nowhere naturally, but is a purely artificial product in saccharine solutions. In wine and other spontaneous fermentations, the initial forms are not yeast, but lower forms which develop into yeast. The lower forms of germ which are concerned in pathogenic processes, require for their development some albuminous compound, in which they set up putrefactive changes, and produce a septic poison. Like yeast, they require oxygen to commence the fermentation, but are said to be killed by excess of oxygen.

Nägeli asserts that a form which is thriving in one particular fluid, may have its action destroyed by another form grown in a different fluid; and he maintains further, that it is possible, by cultivation, so to alter the properties of a bacterium, that it no longer has the power to produce the changes originally associated with it, and that thus, by change of conditions, varied functions may be set in action.

Billroth held, too, that one species may produce various results according to soil; but this is denied by Klebs and Cohn. Professor Büchner found that hay-bacillus acquires virulent properties when cultivated in albuminous fluids, and Dr. Gräwitz has seen the same result occur in the case of *aspergillus*.

The poison generated in dead albuminous substances has been shown by the researches of Gaultier (*Journal de l'Anatomie*, September 5th, 1881) to be a fixed alkaloid with very active properties. Selmi, who confirms Gaultier's experiments, has shown that these alkaloids, or ptomaines, cause "dilatation and irregularity of the pupil, instantaneous retardation of the heart's action, convulsions

and death." (BRITISH MEDICAL JOURNAL, December 17th, 1881.) It is asserted by Klebs that the poisonous principle in such a disease as anthrax, is not communicated except through the germs; that if these be removed by filtration through clay, the filtered fluid is innocuous if injected into the blood. Harley's experiments, on the contrary, show that filtered fluids which have undergone previous decomposition, caused death with great rapidity.

I may mention here an observation which I made in 1864, which is not without interest on the subject of bacteria. In the hospital here, which at that time, from defective sewers and bad ventilation, was in a bad sanitary state, we had some severe cases of erysipelas, and one or two of pyæmia. At my request, the then house-surgeon, Dr. Buckle, sent to me a chip from the floor under each of the beds. These were numbered, but the position of the beds was unknown to me. I had no difficulty, however, by microscopic examination of the wood, in determining, from the presence and number of bacteria, which were the beds occupied by the severe cases.

Micrococci, or coccobacteria, have been found in various diseases, as in measles, small-pox, cattle-plague (Beale), in erysipelas, in acute abscess, and the discharge from wounds antiseptically treated. They have been regarded as the contagia in these forms of disease, and are considered by Dr. Sanderson to be mainly composed of albumen, and he considers that there are innocent as well as malign organisms; and from the observations of Nägeli, Büchner, and others, it is pretty certain that the injurious character of germs is acquired by cultivation in albuminous fluids, and that, when so acquired, the new properties are capable of indefinite extension in the same form. This is very nearly the view held by Mikulicz. That these minute organisms exist in blood-poisoning, is made fully evident, but as Dr. Ogston points out, a single negation destroys them all. One set of observers, as Pasteur, Billroth, etc., ascribe to them all blood-change, while others, as Dr. Watson Cheyne, regard them as harmless. (BRITISH MEDICAL JOURNAL, March 12th, 1881.)

From this it would appear that the species of ferment is determined by this newly acquired power of selection from the surrounding media, or else that the germ carries with it a portion of virus, the germ itself acting only as the originator of catalysis, the virus determining the form and fermentation. If this change of appetite in the germ be proved, as I think it can be very easily, it affords a rational explanation of the so-called "specific" forms, a belief in which rests solely on the varied phenomena of contagia, and not on actual differences of forms as distinguished by the microscope; for it would be the height of absurdity to suppose that anyone can make such distinctions between the most minute initial forms of contagia, which, as Dr. MacLagan admits, must often be invisible with the highest powers of the microscope. But this is not the time to enlarge on this question. I would merely mention here one fact in connection with the subject of specific germs, and it is, I think, one full of meaning.

The germs met with in surgical processes are, as we have seen, of non-specific or indifferent kinds. If, in a strictly surgical case, we were to find a form of germ arising, with a power of exciting a new form of fermentation, highly infective, and generating the same form of disease, just as occurs in any of the eruptive diseases, we should, I imagine, be justified in regarding "specific" forms as of very doubtful reality. Now, in puerperal fever we may find the condition I have mentioned. A new power of fermentation springing up under surgical conditions in which it would be unreasonable to suppose specific forms to exist, and in which, therefore, we can only account for the new properties by an alteration in the ordinary forms of germ.

It has been asserted by some observers that these forms are capable of passing one into the other. Nägeli holds this opinion, and Billroth has made observations which tend in this direction.

Dr. Klein's researches on bacillus anthracis are opposed to the change of pathogenic into septic bacteria, neither does he find the virulent character of the bacilli diminish by cultivation as Pasteur asserts. (*Medical Times and Gazette*, March 10th, 1883.)

M. Pasteur asserts that micrococcus is never converted into bacillus: that he has never seen it, and that therefore it cannot be; that any such belief is wrong, and that everyone is wrong who does not believe in the specific nature of germs.

If dogmatic assertion could be received as equivalent to demonstration, Pasteur's position in this matter might be regarded as unassailable. But I venture to think that the fact of his not having witnessed the process of transformation is no evidence at all of its not occurring. He might on the same grounds deny the specific identity of a hen and her chicken, because he had never seen the one developed from the other. It would require long and patient

and incessant watching over many days to see this process continuously to its completion, even could the conditions necessary for growth under observation be maintained, and this is by no means easy. But there are certain facts which can easily be observed. Just as in the development of the chick, you can see as it were the egg laid. Yeast can be so manipulated that you have nothing but eggs, or micrococci; with other changes, you can see the yeast become a bacterium. You can see and watch the growth of this into bacillus, the chain of tubes gradually diminishing to the extreme attenuation of vibrio, and spirillum-forms, without any break of continuity. This I have observed any number of times and can readily demonstrate.

In the cultivation of microbacteria they can be seen to undergo change into bacilli. Mr. Cheyne says he has never met with an instance in which a micrococcus has become a bacterium or *vice versa*. (P. 243.)

If they do not grow into bacteria—into what do they grow? It would be strange indeed if they existed continually as micrococci, and if bacteria retained always that form. Any such supposition as this is certainly negated by much observation and many facts.

Since this paper was written, I have made some experiments with pus as a ferment, and have found it capable, under certain conditions, of producing alcoholic fermentation in saccharine solutions. The pus contained, when examined microscopically, only a few bacteria and very few micrococci. A distinct vinous odour was produced with an escape of carbonic acid, and the formation of a "yeast" on the surface. The test solutions exhibited no change whatever. The ferment therefore must have been the bacteria, the micrococci, or the pus itself.

There are thus two distinct forms concerned in the septic process, the first of which, bacteria, are specially concerned in causing putrefactive changes, and are very susceptible to the action of carbolic acid, while the coccobacteria are said to be of two kinds, innocent and malign, and to be unsusceptible to the action of carbolic acid.

Koch states that the spores of bacillus anthracis can resist 1.20 watery solution of carbolic acid for a considerable time. (Cheyne, *Antiseptic Surgery*, p. 258.)

The resistance which germs offer to the destructive action of antiseptics is not less remarkable than the fact of putrefaction being prevented by solutions which are admitted to be insufficient to kill the germs.

Those of you who followed the controversy on spontaneous generation which took place some years ago will remember the extraordinary difficulties which have to be surmounted in the destruction of germs, which were proved to possess a singular degree of vitality. And it must have occurred to you as at least a curious fact that when all these precautions had failed to ensure perfect asepticism, this should nevertheless be easily accomplished by a one or two per cent. solution of carbolic acid.

It may also have occurred to you as equally curious that if germs were destroyed with such difficulty, they should be so readily killed in vitalised animal fluids, which must themselves be more easily killed than the germs they contained.

"Once micrococci have gained access to a wound, it is not easy to eradicate them. Ordinary Lister's dressings will not do so (eight cases). After weeks of dressing with carbolic lotion (three cases); carbolic oil, 1:16 and 1:8 in strength (eight cases); after the use of dressings with boracic lint (four cases), salicylic acid (one case), and chloralum (one case), all carefully and thoroughly applied, they were found in the wounds and ulcers in nearly as great numbers as before; and it was clear that these applications, at least as ordinarily employed, *although generally sufficient to kill bacteria and bacilli, are powerless to eradicate the micrococci*. The only way in which I succeeded in destroying them in wounds, where they had once established themselves, was by cauterisation with strong solution of chloride of zinc, or by strong frictions with five per cent. watery solution of carbolic acid—the ordinary 1:20 lotion." (Dr. Ogston, BRITISH MEDICAL JOURNAL, March 12th, 1881.)

Many observations have been published proving that the blood and tissues have the power of ridding themselves of germs. Dr. Ogston's experiments on this point are of singular interest. He found that micro-organisms were present in all acute but not in chronic abscesses. Twenty experiments were made on guinea-pigs and mice by injecting pus from cold abscesses into the tissue of the back. "The invariable result was that no illness or abscess ensued; that the pus was, within a week, dried up into a film pervaded by living cells; and that within ten days this film had become totally absorbed; so that no trace of it remained when the animals were killed, and the site of it was undiscoverable."

But when pus containing micrococci was injected in the same manner, symptoms of blood-poisoning ensued, and lasted from two to five days. "The mice showed the purulent conjunctivitis described by Koch, in his experiments on septicæmia" (a symptom which occurs also in pyæmia in the human subject); "but after a time varying from five to seven days, the animals became active, and seemed well. Those which were killed during the period of fever were found to have the blood teeming with micrococci, eight or nine times more numerous than they were in the fluid injected; and, at the point of injection, an abscess-cavity had formed, with more or less disintegration of the surrounding tissues. In those killed during the stage of convalescence, micrococci were found more rarely in the heart-blood, and the infiltration of the organisms into the tissues around the abscess no longer existed, having been replaced by a firm thick wall of granular tissue, in which micrococci could seldom be detected."

Mr. Lister, referring to these experiments, admits that micrococci must not be regarded as the essential cause of inflammation, and that their occurrence in acute abscesses was due to lowered vitality; an admission which rather increases than solves the difficulty, for one would have supposed that lowered vitality was rather characteristic of the cold abscesses in which germs did not exist.

Mr. Cheyne asserts that micrococci grow with greater rapidity in pure oxygen "than under any other circumstances which he has tried" (page 255); and yet, in speaking of the open method of treatment, he says that "another antiseptic advantage is gained by the free admission of oxygen to the discharge."

Though always believing fully in the germ-theory of disease, I have long had the conviction that destruction of germs by the Listerian method did not fully explain all the success in surgical operation. It was in 1866, in the early days of the system, that a case came under my care which seemed to warrant the belief that the whole truth was not thus conveyed. A man, aged 74, while in a state of intoxication, fell over the threshold of his stable, and sustained a fracture of the tibia and fibula in the upper third. Unable to make himself heard in his calls for help, he attempted to walk, and thus forced the broken tibia through the skin and through his trouser, the end of the bone coming in contact with the manure. He bled very profusely, and when I saw him was in such a state of collapse, that amputation was out of the question. The bone, which was covered with dirt, having been carefully wiped, but not washed, the wound was enlarged to admit of reduction. The clot in the deep and extensive cavity in the leg was left untouched, no water being used. A compress soaked in blood was laid over the wound, and the limb put up in splints. A piece of lint soaked in strong carbolic acid was laid over the compress, fresh acid being poured on from time to time. There being no discharge from the wound, the limb was not disturbed for a month; and, at the end of that time, the wound was found perfectly healed, without a trace of supuration, and the bone was well united. Here we see an aseptic result without antiseptic treatment, properly so called. In this case, germs must have been present in abundance; and yet the blood-clot with which the wound was filled became organised. Mr. Lister considers that the organisation of clots depends on the exclusion of germs, but one such instance as that I have given shows that this is not the real explanation.

It has been asserted that the organisation depends on the inherent vitality of the clot, but this, again, can only be in a measure true, because the circulating blood, which is as fully vitalised, does not always resist the action of germs, which it ought to do, if this supposition be sufficient to account for the resistance.

Mr. Lister's later experiments on this subject tend to prove that germs have no power of causing fermentation in thin layers of blood-clot or albuminised fluids placed between two healthy tissues.

Mr. Cheyne points out the fact that extravasated blood, clotted and free from odour; if opened and the air admitted, becomes in a few hours fetid and putrefied; whereas, if kept in a flask, the same blood would remain sweet for weeks, even after the admission of germs; and the same is true of pus from chronic abscess connected with carious bone; so that it would seem that some other conditions are necessary for putrefaction besides the admission of germs.

What are these conditions? or rather, what are the conditions which oppose putrefaction, and how are they maintained? These are questions which must lie at the root of the matter; and, if they can be answered, it seems to me that the main points of antiseptic surgery become greatly simplified.

As to the success of abdominal operations without antiseptic precautions, Dr. Bantock states that, in a series of cases in which they were omitted after the operation, no bacteria appeared in the

drainage-tube, though this was many times exposed to the air. And he remarks, on the value of the drainage-tube, "It has been shown over and over again that the leaving even a small quantity of bloody serum to the chance of being absorbed, is a much more serious matter than the leaving a like quantity of blood."

It can scarcely be alleged, in the cases of colloid tumour removed by Dr. Bantock, that the tissues were in a healthy state, and yet they were capable of resisting the action of germs; so that there would appear to be some other factor at work than "a healthy condition," otherwise, all unhealthy conditions should lead to disaster.

Ogston found that pus and micrococci injected into the peritoneum of mice and guinea-pigs, produced symptoms of blood-poisoning for several days, after which they recovered (BRITISH MEDICAL JOURNAL, March 1881). He inquires how it can be explained that germs "so deleterious when injected, as they are found in the pus of acute abscess, into the subcutaneous tissues of animals, are yet so harmless on the surface of wounds and ulcers."

The reflection would then naturally arise, that, inasmuch as the germs may fail to act, and, instead of developing, may actually disappear, there must be some other mode of explaining their disappearance than the mere action of the so-called germicide; and, when it became evident that germs disappeared, if not with equal certainty, in some conditions where germicides were not used, we have to fall back upon some such explanation as this, "that the blood and tissues, when in a healthy state, have the power, as Cheyne says, of destroying germs when they are introduced into the body."

It is quite true, as shown in Harley's and Ogston's experiments, that the blood is capable of getting rid of germs when injected into the circulation; but it would be strange indeed if this were by any germicide power in the blood itself; strange if the blood were able to kill where carbolic acid is alleged not to kill germs. And so with the tissues; if healthy blood and healthy tissue suffice to kill germs, where is the need of antiseptics?

We have, in truth, no evidence whatever of any such power in either blood or tissues, and I can see no ground for such a belief, beyond the fact that germs disappear when in contact with them. How they disappear is another question. But is it not reasonable to suppose that when unable to act on any fluid, by reason of its stability, and thus obtain their proper food, they die, and become disintegrated? The maintenance of the healthy state which is thus able to resist germ-action must depend on the removal of impurity and the supply of new material; hence, every healthy function of the body is antiseptic, because it tends to maintain this equilibrium.

In speaking of yeast, I mentioned a fact of importance in connection with surgical treatment, and one helping to explain the class of cases under consideration—viz., that a certain degree of saturation is an obstacle to fermentation, even when germs are present in abundance. For instance, simple syrup will not undergo fermentation, even though the surface be covered with fructifying fungi. Pasteur alleges this to be due to exposure to the air, which destroys the activity of the germs; but this is only a partial explanation, because it will not ferment, if air be excluded, so long as it is kept at rest; but if it be so placed that it can absorb water, or if water be added and the fluid be shaken, fermentation at once begins.

So with bacteria. Concentration of fluids hinders, and dilution favours, their action. Now, why is this? Because dilution favours movement of particles, and hence promotes the catalytic action of the germs. No other change than this would seem to be necessary.

In wounds, this concentration may be effected in several ways.

1. In open wounds, as formerly advocated and practised by Professor Humphry, inspissation of fluids is produced by exposure to the air; and I need not remind you how excellent and aseptic were the results thus obtained.

2. The same kind of action occurs in healing by scabbing.

3. Then there is the process of drainage, which leads to the same end, by carrying off the watery secretions.¹

4. There is the inspissation which occurs through the absorption of fluid by the peritoneum in abdominal operations.

This concentration of fluids then limits mobility; and we saw that one of the most striking features in the active yeast-cells was the movement of its nuclei. Recent observations have shown that a similar condition of bacteria, in which the so-called spores are

¹ Mr. Cheyne claims this as an antiseptic method, and remarks: "It is quite clear that if discharge flows away as fast as it is formed, there can be no marked development of bacteria or their products." In other words, they will not grow without something in which to grow.

developed, is the sign of increased virulence in action, and all germs in a state of activity are endowed with motion. Whatever hinders motion retards germ-action, and so we are brought to see the force of those admirable lectures of the late Mr. Hilton, on the value of rest in surgical treatment. If anything in the world is antiseptic, it is rest.

But if concentration hinders catalytic motion, it is equally certain that dilution favours it, and thus sluicing the wound with water is eminently calculated to produce this end. But water does more than this; it devitalises the clots which are hanging from the cut vessels, and thus leaves so many foreign bodies to undergo septic change.

In the history of the antiseptic treatment you must have noticed how gradually some of the details which were originally considered essential to successful results, have lost a certain amount of importance, while other details have acquired greater prominence. Thus, as the spray has lost ground, more importance is attached to drainage and ligatures capable of absorption.

And it is noticeable also that of late more and more prominence is given to aseptic treatment. Thus, Dr. Cheyne, in his recent work, the most admirable and complete yet produced on the subject, says, "the method we have agreed to term the aseptic method of treatment, is nothing more or less than a series of experiments on the germ-theory of putrefaction. Experiments made with the object of rendering atmospheric dust inert before it reaches the wounds."

This statement, so far as it goes, is fairly expressive, but it is apparent that its scope is too limited. Aseptic surgery, meaning that which prevents putrescence in wounds, must mean a great deal more than is here stated.¹ For it has been shown already that wounds in which the germs have not been thus rendered inert, are still capable of being made to heal aseptically—and it may be fairly asserted that the aim of all good surgeons is and always was to produce an aseptic condition; though it was left to recent times to explain on what this condition depends. Much of the old treatment, moreover, was, as Mr. Cheyne points out, antiseptic, and there is perhaps no better or earlier instance of this than the oil or wine mentioned in the parable of the Good Samaritan.

With some show of reason is the complaint made, by Mr. Morris I think it was, that we might imagine before the Listerian system there was no surgery. It must be admitted that the system has appropriated to itself the whole domain of surgery—for we now find that it claims as antiseptic every detail of surgical procedure. But when these are said to be antiseptic, it is, in fact, only another way of stating that the aim of all surgery is antiseptic. That surgery is good only when it fulfils these conditions, and favours the healing of wounds.

Now, as germs only grow—for the most part at least—injuriously, in dead or putrescent material, the object of surgery must be to leave no nidus for them to grow in, and the more completely it fulfils this end the better and more antiseptic it becomes.

If we wish for an example of perfect surgery, we may take the gardener's art of grafting. Here is an operation, not performed "antiseptically," which yet yields an aseptic result, though the juices of the plant are as much exposed, and as liable, to the attacks of microzymes as are those of the human subject. This result is obtained by the wound being cleanly made without leaving any dead or foreign matter in it, the cut surfaces being perfectly brought together and maintained in a fixed position in a state of rest. If these conditions be fulfilled there will certainly be union, for there is no nidus on which germs can develop. If, on the other hand, there were vessels to be tied, sloughs to separate, clots of blood hanging out of cut vessels and devitalised by sluicing with water—said water commonly teeming with germs; if there were a bone to be sawn asunder, leaving the dust in the wound, and jagged edges to irritate the cut tissues; if the increased secretion of fluids, caused by this kind of irritation, were pent up in the wound; if the graft were loosely inserted, so that it could be blown about by the wind, leaving the edges of the wound in a constantly varying position, would the gardener, think you, look for a successful issue?

Similar conditions to those found in grafting are needful in surgical operations. There must be the clean cut; the thorough removal of all dead or decomposable matter, of all vegetated clots, and all sloughing tissues—the vessels closed by ligatures, which are absorbed; there must be perfect adaptation of surfaces and edges; and complete rest of all the parts until union is secure. According

to the extent to which these points are carried, will be the degree of asepticism.

In perfecting the details which aid in obtaining this result, no one, I suppose, has done so much as Mr. Lister, with his improved forms of ligature and drainage; to say nothing of his varied antiseptic appliances, and all the thorough cleanliness of instruments and surgical material on which he so much insists. Of these I need make no mention here, my object being to point out the mode in which we may explain the production of an aseptic result without the aid of the so-called antiseptic treatment; not that any of such aids are to be undervalued or neglected, but because if we once arrive at the *rationale* of healing under the simplest conditions, it cannot fail to help us to a better mode of dealing with the more complex.

From what has been stated, then, we may conclude that in all wounds the healing process depends on three conditions: First, the complete removal of all decomposable matter, so that there is nothing in which germs can develop. Next, that the fluids which of necessity remain in the wound should be so drained of their watery elements as to leave sufficient concentration as a bar to catalysis. And thirdly, since motion is the material excitant of ferment, absolute rest of the wounded parts tends to prevent effusion of fluids and to favour absorption, and thus helps to fulfil the second condition. Assuming that these three propositions are true, and that they are adequate to explain the healing of a simple incision, it is obvious that they must also lie at the root of all surgical procedures; and you will observe that this view in no degree opposes, but rather supports, the germ-theory.

In putting before you these crude and imperfectly digested remarks, I have purposely left out of view the method of Lister; not, you may be sure, as undervaluing it, for no thinking person can fail to see the enormous benefit which has accrued from it, but with the view of trying to show on what simple conditions the healing process depends, and how these may be insured. I am well aware how imperfectly I have succeeded in my endeavour, and I can only throw myself on your generosity to pardon those shortcomings of which no one is more painfully conscious than I am, and offer you my thanks for the patient hearing you have given me.

AN ADDRESS

ON

MODERN OBSTETRICS.

Delivered at the Annual Meeting of the Yorkshire Branch.

By J. H. KEELING, M.D., F.R.C.S.,

Surgeon to the Jessop Hospital for Women, and to the Sheffield Public Hospital and Dispensary.

GENTLEMEN,—Acknowledged talent, or respectable seniority, is the *ultima ratio* which guides us in the choice of a president for this and similar societies. The talented ones are few in number; the recognition of their gifts is slow; hence the advantage of having a second class from which to choose in case of need. Were talent and attainment the sole admissible qualification, the large majority of us would be hopelessly excluded. As it is, all things come to him who can wait, and any of us may hope in time to acquire such age and respectability as will lead to the presidency, should there happen to be a dearth of other and more valid claims. In the name of the respectable seniors I beg to thank you, very heartily, for the honour you have done them and me in choosing a president from their ranks, and to express a hope that, as the alternative of choice which puts them in possession is only an occasional one, the *prestige* of the chair will not thereby be seriously diminished.

Some philosophers assert that man has won his supremacy in the animal kingdom mainly by the saving grace of speech; by his superior power of communicating and perpetuating his slowly increasing stock of knowledge. To whatever extent heredity and surrounding circumstances might develop the admirable instincts of contemporaneous animals; they were ultimately left far behind in the race with man; because he alone, or in a far higher degree than they, could accumulate knowledge, diffuse it readily through the primitive communities which his gregarious nature led him to form; and hand it down to his successors as a starting point for further accretion. Be this theory of olden time a tenable one or not, it is unnecessary, in modern days, to dwell on the advantages

¹ I need not here do more than point out the real elasticity of the term "aseptic," which covers all the ground of healthy healing—from the prevention of putrescence to the complete exclusion of germs and their devitalisation.