This may be guarded against by the care of the assistant in charge of the speculum, who, by judicious leverage of the thumb and finger, can control and hold the eyelids away from the globe. The other is when the surgeon is using the cystotome for rupturing the anterior capsule, and a certain amount of pressure is of necessity made upon the lens. This danger may be avoided by making the holding forceps which grasp the conjunctiva below the cornea so to press against the eyeball as to steady the lens towards the cornea and cystotome.

THE TENDENCY TO ABANDON IRIDECTOMY IN EXTRACTION OF HARD CATARACT.

Having been for many years convinced that for all but exceptional cases an operation involving iridectomy is not the best method of extraction of hard cataract, it has been a matter of interest to observe the increasing tendency of ophthalmic surgeons to move towards the same opinion.

One of the earliest ophthalmic writers in England to publish a series of operations by a "shallow flap" without iridectomy was Mr. Snell of Sheffield, who was my assistant and house-surgeon in 1870-72 at the time when I was beginning to adopt the shallow flap and to abandon iridectomy. He tells me that of his last 200 extractions at the Sheffield Infirmary there were but 13 combined with iridectomy, of which 10 were preliminary to Förster's operation for immature cataract, and two or three were accidental at the time of operation.

In 1885 Galezowski began to operate without iridectomy. Of 1,365 cases reported, 1,173 were without iridectomy, 179 with iridectomy, and 13 with sphincterotomies (division of the circular fibres of the iris).

In 1886 Knapp, of New York, began a series of operations without iridectomy, reporting 450 "simple extractions," against 371 cases "with iridectomy."

In 1888 Professor Schweigger, of Berlin, began to abandon iridectomy, reserving it for special cases. Of 465 operations, 400 were "simple extractions."

De Wecker (Paris) writes, in November, 1892,³ on "simple extraction" and the "combined operation." He says: "The extraction of cataracts with iridectomy is not—and M. Fuchs, of Vienna, agrees with us—the safest. The safest to avoid a large prolapse, yes, but there its advantages cease." He lays down the rule that "with a perfectly ripe cataract in a healthy patient simple extraction is the proper operation to perform, but if the cataract is not ripe, or the hygienic conditions are unfavourable, an iridectomy should accompany or precede the extraction." On the other hand, Landolt (Paris), having written to a large number of ophthalmic surgeons to ascertain their views on extraction of cataract at the present date, sums up in favour of extraction preceded by iridectomy. It is clear, therefore, that the confidence of ophthalmic surgeons in iridectomy as an adjunct to extraction is being seriously shaken, and that opinion is ripening in the direction of some form of simple extraction.

The operation of so-called "simple extraction" to which some have reverted has been apparently the old semilunar flap with the incision close to or even within the sclero-corneal junction. It was in order to obviate the disadvantages of this "simple extraction" that Graefe invented his "linear extraction with iridectomy." It would seem, however, from published records that even with all its disadvantages the simple extraction by semilunar flap without iridectomy attains results equal to those obtained by Graefe's operation. But the exact method of operation which I am advocating differs essentially from both of these in that the incision is entirely within the cornea, almost linear, and yet without iridectomy. And if I am right in advocating a method of operation which I have employed for so many years, and which has been attended in a very large proportion of cases with most satisfactory results as to vision, and comparative freedom from complications as well as to perfection of scar, pupil, and anterior chamber, I cannot but think that a surgeon, who would give a full trial to the method described and the rules laid down, would surpass, in visual results and in freedom from complications, his former successes with either the so-called "simple extraction" or the Graefe operation with iridectomy.

³ Archives d'Ophthalmologie.

THE BACTERIOLOGY OF VACCINE LYMPH, WITH SPECIAL REFERENCE TO AN IMPROVED METHOD FOR ITS STORAGE AND PRE- SERVATION.

By S. MONCKTON COPEMAN, M.A., M.D. CANTAB.,
Lecturer on Public Health, Westminster Hospital, and late Research
Scholar of the British Medical Association.

DURING the last two or three years I have been engaged in an experimental research on the pathology and inter-relations of variola and vaccinia, certain of the results of which I have published elsewhere. In the present paper I desire to direct attention to the study of the bacteriology of vaccine lymph, and to the lessons which may be learnt from such a study, as to the means of storage best adapted for securing sustained purity of the lymph and the unimpaired manifestation for indefinite periods of the action peculiar and essential to its use.

In the volume recently published of the *Transactions* of the Bacteriological Section of the International Congress of Hygiene, held in London in August, 1891, will be found two papers dealing to a greater or less extent with this subject; the first by myself, the second by Professor Crookshank.

Although working quite independently, we both arrived at the conclusion, in which we are corroborated by Pfeiffer and many other observers, that although numerous bacteria can be grown in various nutrient media from specimens of vaccine lymph obtained in the ordinary way, yet that to none of these could be assigned the rôle of the actual vaccine virus, which as yet remains unidentified. For this reason I had assigned to these bacteria the term "extraneous," signifying thereby that their presence is not in any way essential to the successful action of the vaccine lymph. In this also Professor Crookshank agrees with me, for he says:

None of these different species of bacteria are peculiar to vaccine lymph; there is no bacterium constantly present in human and calf vaccine, and there is not one which can be regarded as the contagium. To sum up, most of them are well-known saprophytic bacteria, and some are identical with bacteria commonly found in suppuration. Vaccine lymph is a most suitable cultivating medium for micro-organisms, and bacteria invariably get access to the contents of the vaccine vesicle.

A lengthy list is given by Crookshank of the various bacteria which may be isolated from human or calf lymph by the method of plate cultivations, but he does not state whether any—and, if so, what—precautions had been taken with regard to the collection of the lymph with which he experimented, neither does he attempt to distinguish between those bacteria which are commonly to be found and those whose presence is exceptional. I have shown, however, that there are three species of micro-organisms, one or all of which are almost universally to be found in every specimen of vaccine lymph examined, of which one—the staphylococcus albus—is usually to be found in the upper layers of healthy skin. Of more importance is the fact that in certain cases, though rarely, I have been able to satisfy myself as to the presence of the streptococcus pyogenes, and, moreover, it is on record, in certainly one instance at least, that the streptococcus of erysipelas has also been isolated from a specimen of vaccine lymph.

That untoward results should occasionally, and, in certain cases, follow the inoculation during the act of vaccination of one or other of the various "extraneous" organisms which may be present in the lymph employed is not to be wondered at; indeed, I take it that it is rather a matter for wonder that the evil results following the present somewhat empirical practice of vaccination have been in the past so few in proportion to the vast numbers that have undergone the operation. Still, in view of the feeling against vaccination which is prevalent at the present time, it is most desirable that we should not, if it be possible to avoid it, run any risk of performing a septic inoculation on a patient under the guise of vaccination.

If only it had been possible to isolate the contagium of vaccinia (or variola), and to carry on, without loss of specificity, pure cultures of it in some nutrient medium from generation to generation, this portion of the problem would be solved;

but although the number of observers who have turned their attention to this point is legion, and although a claim to such a discovery is every now and again advanced, success cannot as yet be said to have been attained. Fortunately, however, we have at our disposal other means of satisfactorily insuring the purity of vaccine lymph.

Some two years ago, when experimenting on the possibility of isolating the specific contagium of vaccinia and variola, it struck me that the exuberant growth of evidently "extraneous" organisms, which I obtained in all the various nutrient media employed, might be capable of superseding the more important organism for which I was seeking. I therefore turned my attention to the discovery, if possible, of some means of treating vaccine lymph which should inhibit all "extraneous" organisms without injuring its potency for vaccination.

Another point which directed my research work at that time in the direction I have indicated was that my attention was called to the opacity which commonly occurs, after a longer or shorter period, in lymph which has been stored in sealed capillary tubes, and to the deterioration in activity of the lymph which is found to be a concomitant of such opacity.

In former papers I have shown that the opacity of old stored lymph may be quite independent of any coagulation in the lymph, as no coagulum was found on breaking many of the tubes in which it was most marked. Further, I have shown that if cultivation experiments are carried out with the contents of tubes which have become opaque, and also simultaneously, for purposes of control, from tubes of comparatively fresh lymph, many more colonies result in the plates poured from inoculations of the old tubes than in those for which more recent lymph is used. I concluded, therefore, that we are apparently justified in considering that the opacity of old stored lymph is, in the main, the outcome of an enormous multiplication of aerobic bacteria, the ancestors of which were present in the lymph when first taken, although their numbers were then so comparatively small as not to render it in any way turbid. These evidently find in the lymph, especially when removed from the body, a suitable medium for their subsequent multiplication, while at the same time it would appear that such growth has the result of gradually inhibiting the specific effect proper to the vaccine virus itself. In this case also, then, the obvious indication was not only to prevent such multiplication of "extraneous" organisms subsequent to storage in the usual manner, but, if possible, to remove them altogether without injury to the actual contagium of vaccinia.

Without detailing the various experiments which were carried out with this object in view, a full account of which I have already published, it is necessary in this place to state briefly the lines on which the work was carried out. In the first place I made trial of the method of fractional heating which had, in the hands of Kitasato, met with such brilliant success in the isolation of the bacillus of tetanus. Proceeding in this manner and in every experiment observing the precaution of making control cultures, I presently arrived at a temperature, exposure to which is apparently incompatible with the continued existence of those micro-organisms which can ordinarily be grown when vaccine lymph is inoculated into nutrient jelly. The required temperature ranged between 38° C. and 42° C.; but whereas after exposure for an hour at the lower register a few points of growth are occasionally seen in plate cultivations after the lapse of a day or so, while the higher temperature sometimes appeared to exert an injurious effect on the lymph, as far as regards the normal vesiculation which should result from its inoculation in the living animal, I sought for some method of readier application and requiring less delicate manipulation. This I at length found in the admixture with the lymph of a certain proportion of (75 per cent.) glycerine in distilled and sterilised water prior to storage in capillary tubes, which latter also had been sterilised by heat.

Many years ago Müller showed that lymph might be diluted with three times its bulk of such a mixture and still retain its properties unimpaired, a fact which has been taken advantage of at many of the Continental vaccine stations, and by more than one purveyor of trade lymph. An argument in favour of the use of lymph diluted in this way with glycerine is found

in the fact that such a mixture does not dry up nearly as readily as ordinary lymph and therefore in the hands of operators, all but the most expert, affords greater facilities towards the attainment of a uniformly successful series of vaccinations. The fact also that a much larger supply of lymph is thus made available is so obvious that it need not be insisted on.

Not only is lymph thus treated effective as vaccine, in the old sense of the word, but as time goes on, instead of losing its effect on inoculation, its potency actually becomes increased. Experiment shows also that in tubes filled with such diluted lymph, opacity does not apparently result. As I have previously stated—an observation, by the way, for which I may fairly claim priority—the glycerine inhibits the growth of, and after a longer or shorter interval kills off altogether, those aerobic bacteria which I have termed "extraneous." This effect may be demonstrated by making from tubes of glycerinated lymph of equal age a series of plate cultivations at gradually increasing intervals of time, together with control cultivations from tubes of untreated lymph. (Photographs of such plates have been taken, but are not reproduced here).

With the assistance of Dr. Cobbett I have also carried out a series of glycerine experiments on a larger scale, not only with the organisms which can be grown from vaccine lymph, but also with numerous other species of bacteria, both pathogenic and saprophytic, in nature. With details of these experiments, which we shall hope to publish shortly, I do not propose to burden the present paper. I will here merely state that the net outcome of our work appears to show that while some pathogenic organisms remain active in admixtures of broth and glycerine, or even in pure glycerine for longer or shorter periods, other pathogenic, and as far as our experiments go, all saprophytic organisms are killed out in from three or four days to as many weeks.

At the time of writing, I have seen for the first time a paper (dated September, 1892) by Achille Sclavo, Director of the Health Bacteriological Laboratory at Rome, on the Preservation of Viruses in Glycerine. In this paper, which is very short, the author does not do much more than just refer to the use of glycerine as an addition to vaccine lymph, and has obviously not altogether appreciated the importance of the results to be derived from such admixture. Indeed, he appears to mention it merely as an exception to a rule, which he considers fairly general, that many bacteria are preserved rather than destroyed by glycerine. As, however, he confirms in several particulars the results at which we have arrived, it will be well briefly to epitomise the paper in question.

Glycerine is added nowadays in almost all vaccine institutions to vaccine emulsion, which by this means preserves its virulence for months and even for years. As a proof of this I adduce the following: Dr. Krieger, after some experiments with calf lymph, overlooked a bottle of lymph in a press. He found it and used it eleven years afterwards, producing normal pustules and passing it through other subjects. The virus of rabies, too, remains unaltered in glycerine for a long time (Roux), and is active after six months (Uffreduzzi). Further, many bacteria live well in glycerine, and they may be found preserved in glycerinated vaccine emulsion for various lengths of time. Their number, however, gradually diminishes, so that after some months' preservation the emulsion may retain its specific activity but contain only a sparse number of living bacteria. I have extended my experiments in glycerine preservation to pathogenic bacteria found in the tissues of animals dead of infectious disease, using quite neutral unsterilised glycerine. I put spleens of such animals into 80 to 100 p.c. of glycerine and kept them at the temperature of the room. Teased portions were subsequently inoculated subcutaneously in living animals. The bacteria used were the diplococcus of Fränkel, the bacillus of fowl cholera, and that of anthrax (? spore form).

CONCLUSIONS.

The diplococcus of Fränkel preserves its virulence in glycerine for not less than sixty-seven days (also at forty-four and fifty-eight days).

Bacillus of Fowl Cholera.—Virulent after seventy-four days in glycerine, but killed by stay of four months.

With anthrax virulence gradually decreased, ceasing in one experiment on the seventh, and in another on the ninth day. At earlier periods incubation was prolonged in the living animal, and there was extensive subcutaneous oedema, while bacteria showed a tendency to form long filaments in the blood, so that it may be that the anthrax bacillus underwent a gradually decreasing degree of attenuation in the glycerine.

¹ Sur le Vaccin de Genisse. Par M. E. Deschamps. *Revue d'Hygiène*, N. P., p. 654.

Of considerably greater importance from my point of view, however, is a paper by Chambon and Ménard,² which recently appeared. In it these gentlemen relate their experience of the use of glycerinated vaccinal lymph when kept for a long time in capillary glass tubes previously sterilised and closed by the blowpipe. The results they obtained with lymph originally good were highly satisfactory, and even lymph which, in its fresh state, gave mediocre results, in the course of fifteen days produced a passable vesicle, and, after forty, fifty, or sixty days, a typical one. The improvement seemed due to the gradual extinction of parasitic microbes under the influence of glycerine and time.

Professor Straus made plate cultures with their glycerinated lymph, which showed that when fresh it gave rise to numerous colonies of various microbes, especially *staphylococcus pyogenes aureus* and *staphylococcus albus*, while the glycerine lymph fifty to sixty days old remained absolutely sterile, intermediate specimens presenting fewer and fewer microbes as they became older. These experiments were repeated many times, and invariably with similar results.

This evidence, so entirely corroborative of my own work, is all the more important as it appears certain, from a perusal of the original paper, that the authors were ignorant of the precisely similar results at which I had previously arrived, and which were published nearly twelve months before the appearance of their article.

There can thus, I venture to think, no longer be any doubt as to the superiority of the method of lymph storage which I advocate over the perhaps simpler method which has been so strenuously insisted on in England of late years; and I trust therefore that some authoritative pronouncement may before long be made on the matter, as it appears to me, at any rate, to be one which is of the utmost importance in relation to the present widespread objection to vaccination on the score of the possible dangers incidental to the operation.

THE TREATMENT OF PERFORATED GASTRIC ULCER, WITH REPORT OF SUCCESSFUL DRAINAGE IN A CASE.³

By GILBERT BARLING, M.B., B.S., F.R.C.S.,
Surgeon to the Birmingham General Hospital, and Professor of
Surgery in Mason College.

THE following three cases show how variable may be the result of perforation of a gastric ulcer. In the first we have an example of the most acute kind, in the second there was a localised peritonitis, which at the end of a few days gave rise to general peritonitis, and in the third the extravasated stomach contents remained entirely localised, and never involved the general cavity of the peritoneum.

CASE I.—A girl, aged 22, was seized with severe pain in the abdomen when in the act of stooping, and became very faint. She was admitted to the General Hospital under the care of Dr. Simon, with whom I saw her. Six hours after the seizure the abdomen was a little distended, and rigid, it was tender on deep palpation, the pulse was rather hard, and there was vomiting and hiccough. There was no history of gastric ulcer. The abdomen was opened in the middle line below the umbilicus, and two to three pints of sero-purulent fluid were evacuated, but there was nothing to suggest any source of leakage, although a careful search was made. The abdomen was therefore washed out and drained. Death took place twenty-four hours after the operation. At the necropsy a perforating gastric ulcer was found on the anterior wall, in a position easily accessible for suturing.

CASE II.—A girl, aged 20, was admitted under Dr. Simon, with a history of possible perforation into the abdominal cavity two days earlier. Three years before she had been under treatment for gastric ulcer. Four days after admission the abdomen then being distended and tender, the pulse 150 and wiry, and vomiting being present, the abdomen was opened in the middle line above the umbilicus, and a collection of semi-purulent fluid was found between the liver and stomach. This was emptied and an ulcer found on the anterior wall of the stomach, from which a quantity of watery fluid was escaping. The opening, about half an inch in diameter, was closed with five points of Lambert's interrupted suture, and after washing out the abdomen, a tube was placed between the liver and stomach. Death took place thirty hours after the operation. At the necropsy well marked peritonitis was found, and about a pint of thin purulent fluid was found in the pelvis. The perforation was securely closed.

CASE III. *Leakage from a Gastric Ulcer: Abdominal Section Three Weeks after: Drainage: Recovery.*—I was asked to see this case by Dr. Hugh Snell, from whom I obtained most of the notes. A girl, aged 29, was on

May 8th, 1892, seized with severe abdominal pain, faintness, and vomiting. She had been previously suspected to be suffering from gastric ulcer, and on May 7th she had partaken of a heavy and indigestible meal, and on the morning of her seizure she had her ordinary breakfast. An hour later she felt "something give way inside her," and this was followed by acute pain and faintness, and she looked at first as though she were suffering from internal bleeding. The pain was general all over the abdomen, but was worst in the left hypochondrium; the abdominal walls were rigid and the belly was tender. A provisional diagnosis was made of perforation of a gastric ulcer. All feeding by the mouth was stopped and morphine was administered. Under this treatment the girl improved. A little food was allowed by the mouth owing to the irritable condition of the rectum, and the only complaint was of pain in the left lumbar region on sudden movement. On May 17th there was increased pain in this region and in the left hypochondrium, with tenderness, increased resistance, and some dullness. Two days later these signs had increased, and the temperature was 102° F. From this time to the 27th there was improvement, but on this day the breathing became hurried and the patient was restless.

On May 28th I saw the patient for the first time. Her pulse was 160; temperature 103°; respiration 40; in the left hypochondrium a mass could be felt, and it could be palpated bimanually, but without defining its limits exactly owing to the tenderness. The facial expression was very bad, and altogether the girl was so ill that I hesitated to attempt to relieve her by operation. The incision was directly over the swelling, about the left semilunar line, and on opening the abdomen the omentum was found adherent. After separating this a mass of hard granulation tissue was found, and the finger, breaking this down, passed backwards and upwards in a direction which would lead behind the stomach and almost to where it would be in contact with the spleen. At the bottom of this a small cavity was found, containing not more than a couple of drachms of pus, of an offensive odour. A tube 5 inches long was placed in the cavity and the patient quickly put back in bed. Convalescence was very slow, and it was not until July 11th that the tube could be dispensed with. Recovery was delayed by an attack of phlebitis in each leg. At the present time (April, 1893) the girl is quite well.

The mortality after perforation is probably at least 95 per cent., so that each case recovering after operation may be looked upon as saved from almost certain death. Although the third case proved the most successful, it is clear that resort to operation at the earliest moment after perforation is recognised is most likely to prove serviceable in the large majority of cases. The diagnosis of perforation is as a rule not difficult, but in some cases there may be no evidence pointing to the stomach as the organ at fault; such was the case in the first patient.

From what has been said before, it is evident that the operative measures to be adopted are not always the same, but that they must vary with the condition which is suspected to exist. With the limited experience at present available it is not desirable to dogmatise as to the exact lines to be followed, but the following are the main outlines. The abdomen should be opened in the middle line, but not too near the costal arches. Positive evidence may at once be found in the presence of free gas or food. The area between the stomach and liver should be examined with care, so that any localised collection here should if possible be prevented from soiling the remainder of the cavity. Any extravasated matter having been removed, the perforation should be sought for on the anterior wall, especially towards the lesser curvature, where it will most commonly be found. If it be, the perforation should be sutured, and the most convenient method is by the continuous Lembert suture, the stomach being brought out of the wound if this be possible. If the edges of the perforation are too friable to hold the sutures, paring them to get a firmer tissue would only add to the time consumed, and the case would probably be better met by an extensive infolding of the margins, which could be done without much difficulty and without risk of kinking in the stomach. If the ulcer cannot be sutured, it may possibly be stitched to the lower angle of the incision. If the perforation be inaccessible for suturing, and cannot be brought to the incision, the only resource left to the surgeon is drainage, with a tube leading directly to the point of leakage. Though this falls short of the more complete proceeding, yet drainage has been found so efficient a protection against the extravasation of other fluids, as for instance bile, that one cannot but be hopeful of it in this condition.

Whether suturing be possible or not, it is of the greatest importance that the abdominal cavity should be washed out and thoroughly flushed with hot water. When the flushing has been done, the drain should be placed *in situ* close to the point of perforation, whether it has been sutured or not. It may also be well to introduce another tube through an incision in the lowest part of the abdominal wall, so as to drain the pelvic cavity. The want of this precaution I believe interfered with the well-doing of my second case, in which a

² *Gazette des Hôpitaux*, December 15th, 1892.

³ Abstract of paper read at the Birmingham and Midland Counties Branch of the British Medical Association.