Preface.

I certify the following Thesis to have been written by myself. It relates to an epidemic which broke out in the large village of Brough in the County of Westmorland, and which for long caused considerable alarm, and was looked upon by the inhabitants alternately as Cholera, mushroom poisoning, Dysentery, or some form of fever. The first family attacked was not attended by me, but by a neighbouring practitioner during whose temporary illness I had an opportunity of seeing, on his behalf, one or two cases, and in one of his cases I managed with great difficulty to secure a post-mortem examination, which examination was performed by myself. Also the excreta were frequently examined by me, and the results of such examination confirmed by Dr. Klein of St. Bartholomew's Hospital. The second family being within the range of my own practice were attended by myself but in none of these cases could I procure a post-mortem examination.

I have not found anywhere any adequate description of any similar cases in any
Medical works—Including such works as those by Oliver, Keene, Jansou, Talman, Ruini (Ruini's Dictionary of Medicine) or in any of the ten issues of the Medical Annual from the year 1873 to the present year inclusive.

In the study of these cases I have also consulted the "Manual of Bacteriology" by Maci & Mitchell, Syne's Bacteriology of Everyday Practice—Baker's Botany, and "British Edible Fungi" by M. C. Cooke.

I also certify that I have been in active general practice for almost sixteen years having qualified as M.B., C.M. in the year 1886.

Signed—Thomas H. Gibson
On a fatal outbreak of Diarrhoea due to Streptococci Infection.

The following remarks on an outbreak of infectious diarrhoea in Westmorland may prove of some interest on account of the somewhat obscure nature of its origin, the severity of the symptoms, the heavy mortality accompanying it, and because a similar occurrence in this locality, or neighbourhood, had not previously been known.

History.

The outbreak occurred in a village containing about one thousand inhabitants, chiefly of the agricultural class, and affected a family who dwelt in two old cottage houses bearing date 1878 which had been thrown together to form a single dwelling and which contained low, rather dark and somewhat badly ventilated rooms.

This family consisted of grandmother, father, mother, eight children, and the children's aunt.

Towards the end of September 1901 the grandmother sickened and, after a few days illness, died on the 26th day of the same month — death being certified as due to
gastritis. She had been nursed by her three daughters namely: The married daughter with whom she lived, by an unmarried daughter 45 years of age, and by a married daughter whose home was eleven miles away, and who had with her her youngest child, and who afterwards brought four other children to stay in the house over the funeral of the deceased.

Three clear days elapsed between the date of death and the date of interment. The mother of the second family, whose home was eleven miles away, returned home with her children on the day following the interment; but the seeds of a sickness which ran a deadly course had apparently already been sown, resulting in the loss of eight more lives, taking the two families together out of a total number of thirteen persons who became afflicted with the disease.

Here for the sake of brevity and simplicity, it will be more convenient to tabulate the victims of the disorder according to the date when each became affected, and it will be better to describe the two families under the heads of Family A and Family B.
Family A.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Commencement</th>
<th>Termination</th>
<th>Illness</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (grandmother)</td>
<td>65 years</td>
<td>Sept. 16th 1901</td>
<td>Died Sept. 26th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Male (granduncle)</td>
<td>5 years</td>
<td>Sept. 25th 1901</td>
<td>Died Sept. 27th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Male (do)</td>
<td>6 years</td>
<td>Sept. 25th 1901</td>
<td>Died Sept. 27th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Male (do)</td>
<td>2 years</td>
<td>Sept. 25th 1901</td>
<td>Died Oct. 5th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female (do)</td>
<td>8 years</td>
<td>Oct. 1st 1901</td>
<td>Died Oct. 8th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female (do)</td>
<td>9 years</td>
<td>Oct. 2nd 1901</td>
<td>Died Oct. 8th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female (sister)</td>
<td>45 years</td>
<td>Oct 2nd 1901</td>
<td>Died Oct 23rd 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female (mother)</td>
<td>36 years</td>
<td>Oct 8th 1901</td>
<td>Recovered after 14 days</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Case No 8. had been confined on Sept. 5th 1901 and the baby and oldest daughter had been removed to another dwelling, and they and their father were the only members of this family who did not contract the complaint.

Family B.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Commencement</th>
<th>Termination</th>
<th>Illness</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1 year</td>
<td>Sept. 29th 1901</td>
<td>Died Oct. 1st 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Male</td>
<td>2 years</td>
<td>Oct. 2nd 1901</td>
<td>Died Oct. 7th 1901</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female</td>
<td>3 years</td>
<td>Oct. 8th 1901</td>
<td>Recovered after 22 days illness</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female</td>
<td>11 years</td>
<td>Oct. 13th 1901</td>
<td>Recovered after 14 days illness</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Female (mother)</td>
<td>34 years</td>
<td>Oct. 18th 1901</td>
<td>Recovered after 17 days illness</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Case No. 9 (infant) died within an hour or two after its arrival home from the house of Family A and had had no medical treatment. The father of Family B and a son aged 9 years were not attacked.

The Symptoms.

The onset of the disease was characterised in each case by diarrhoea, soon accompanied by severe griping abdominal pains and the passage of very frequent bloody but not copious stools passed with much straining and tenesmus. In many of these cases this straining and griping would come on at no greater intervals than every ten minutes throughout the twenty-four hours. There was some tendency to vomit. In some cases this was troublesome.

The temperature as a rule showed some elevation. In one case (Case 11) registering in the earlier stages from 101° to 102°, gradually falling to 99°, occasionally becoming subnormal (97.5°) and finally when blood was no longer passed becoming normal; followed a day or two after by cessation of the diarrhoea and straining.

There was a tendency to delirium at times, notably in Cases 10, 11, & 13. In case No. 10
There was not much constitutional disturbance at first beyond the shivering and diarrhoea. The temperature ranged from 100° to 102.5° and the child seemed to be doing fairly well with good hope of recovery when, after four days, illness the temperature suddenly rose to 105.7° and although this by the agency of a bath was reduced to 101°, the child lapsed into a semi-comatose condition, finally became comatose and died. In case No. 3, under the care of a neighbouring practitioner, the termination was the same but after an illness of thirty days. The temperature for a day or two in the early stage having been about 101.5° then falling to 99° and varying between 99° and 97° until towards the termination of the case when the patient, very much emaciated and unable to retain nourishment owing to vomiting lapsed into a comatose condition and died.

The tongue in all these cases was at first covered with a thick white fur, later becoming brownish and if the patient survived gradually clearing from the tip. Throat was very marked. — The pupils of the eyes in all cases were widely dilated.
Towards the end, in fatal cases, the face assumed an ashy, sometimes almost blueish, look.

There were no chest symptoms. The pulse was soft and frequent, sometimes becoming very low and weak, and there was a very great tendency to collapse. The abdomen was not hard, and as a rule not distended.

There was no rash, no enlargement of the spleen, and none of the liver, with the exception of one case (Case 13) where at one time there was a slight enlargement which did not long persist. The urine, when it could be procured unmixed with the stools, was found to be free from albumen. The stools at first consisted of fecal matter mixed with mucus and a considerable quantity of blood; later on they often chiefly consisted of glistening mucus and blood; and later still, in those cases where recovery occurred, the stools became greasy and somewhat shelly, -- the blood and mucus disappearing, and the stools became more fecal in character and gradually passed from a looser state to a state of more consistency as the diarrhoea ceased. As a rule there was no odour, though once or twice in advance
cases, the odour of occasional stools was marked. Sometimes small pea-like pyramids would be passed. Bacteriologic examination showed Streptococci, and other micro-organisms present in large numbers.

Now and again there would be dulness extending upwards from over the region of the oesum along over the region of the ascending colon and merging into the liver dulness. At other times this would have disappeared—showing a tendency for fecal matter to accumulate in this part of the intestine.

Indeed in a post mortem examination held on Case No.6 it was found fecal matter had accumulated in this portion of the bowels to a considerable extent.

In two cases, out of the five cases under my care, there were herpetic eruptions—Herpes labialis being present in Case No.13 and Herpes zoster being well marked over the left side in Case No.12. It will be observed these two cases recovered and perhaps these eruptions indicate a favourable course of the disease in much the same way as herpetic eruptions.
are supposed to do in cases of pneumonia.

In case No. 8 there was swelling and tenderness over the left parotid gland, and this swelling persisted about four days, but had almost entirely disappeared before the death of the patient.

Some idea of the virulence of the complaint may be gained by considering that even counting Case No. 8 which lingered thirty days, the average length of illness in fatal cases was rather more than nine days, while of those cases which recovered the average length of illness was rather more than sixteen days.

- All the persons attacked, with the exception of Case No. 1, were in the first instance strong, vigorous, and healthy.

Post mortem and Bacteriological Examination

There is always extreme difficulty in procuring post mortem examinations in country practice and only after much trouble could one be brought about in the case of Patient No. 8, who, as mentioned above, died after an illness extending over thirty days.

The post mortem was performed on November 1st, 1901 thirty-four hours after
death, and portions of the cecum and ileum,
and also of the ascending and descending
colon with their contents were procured
with a view to their examination by Dr. Klein
of St. Bartholomew's Hospital, whose subsequent
bacteriological report is in accordance
with what follows below.

On opening the abdomen the viscera
were found to be normal in position. The
stomach was distended with fluid. There
was about half a pint of blood-stained
serum in the abdominal cavity. The
vermiform appendix was not adherent. The
cecum and ileum were somewhat
adherent, and there were some adhesions
about the ascending colon. The mesenteric
vessels were somewhat distended. The
gall bladder was distended. The liver,
kidneys, and spleen were normal.

Examination of the cecum and ileum
showed much congestion of the mucous
membrane, but no ulceration or loss
of substance. The descending colon
showed the patchy congestion of the mucosa
more pronounced than the former, but
also here there was no loss of substance and no ulceration. Sections through the hardened colon showed the epithelium entirely gone, but the mucosa showed no loss.

The bacterioscopic examination of the contents as also of the mucous membrane of the colon, showed several varieties of bacillus coli; also proteus vulgaris and what appeared as diplococci. The latter, however, as culture in fluid media proved were really streptococci. These diplococci (streptococci) in the deeper parts of the mucosa formed nests and clumps in the mucosa itself.

The diplococci (streptococci) isolated from the injected mucosa of the colon compared in their general morphological and cultural character with a variety of Streptococcus pyogenes. The culture had feeble pathogenic action on the guinea pig, causing a gelatinous tumour at the seat of injection when used in small doses, but when used in large doses caused death.
The streptococcus was the prevailing organism in these cases. — The Hinkler-Brier Spiritum of Cholera Morbus was not present. Nor was the diarrheaic bacillus mentioned by Blake and Leary.

It would appear that this epidemic was not dysentery but more like that fatal infectious diarrhoea which occurs in children which is due to streptococcic infection and which has been described by Eschenle.

The introduction of the poison into the system in a dwelling such as the one inhabited by these people — a dwelling low, dark, and badly ventilated; shut in to some extent by neighbouring houses, and somewhat overcrowded with inmates during a period of weather exceptionally warm even for that time of the year, — the conditions were favourable for the growth and development of microbial disease. — On the other hand in the matter of privy accommodation and drainage there was little or nothing to find fault with, and in discussing the introduction of streptococcic infection into the system we must consider the various articles of food, drink and liquid consumed.
It is impossible to get a tabulated list of what these various articles were and therefore, a general idea will suffice. They were as follows:—Water, milk, tea, sugar, bread, butter, potatoes, mutton, and mushrooms. Each member of the two families—even the infant (case 9)—had partaken of these articles indiscriminately, with the exception of cases 1. and 13, who had not partaken of mushrooms.

The water was, and is still, procured from a deep well. This water on analysis proved to be good. free ammonia was absent. Albuminoid ammonia was 0.15. It is a water used by many inhabitants of the village, and no other case of similar sickness ever, at any time, appeared amongst them.

The milk was procured from a farmer who supplied many more people amongst whom no sickness appeared. This particular family (Family A.) stored their milk in enameled iron vessels, the enamel of which is liable to become cracked and knocked off in places leaving crevices in which dirt accumulates. This gives a nasty taste to the milk once more home a deleterious action upon it. Yet milk was hardly likely to be the
Starting point of the epidemic because sickness only broke out in Cases 12 and 13 thirteen days after they had reached their own home, and the same argument applies with regard to bread, tea, mutton, butter and sugar. Also I would point out that two children who were removed to another house when the illness began to spread did not suffer although they had shared the diet in common with the rest. None of the above articles could be procured for analysis because they had all been consumed or destroyed at an early stage of the epidemic.

The question of Mushrooms as a causal or predisposing factor of the disease required the most careful consideration and also some care, owing to various contradictory statements, in definitely ascertaining who had eaten of them and who had not. And at first it seemed that all who were affected had partaken of them in considerable quantities.

This appeared to be a matter of great importance because of the almost unlimited supply of these articles and their almost universal use as an article of food by everyone, and probably their excessive use.
Amongst the labouring classes. About this time, too, a death had been reported from Totnes in South Devonshire, which was undoubtedly caused by eating mushrooms. The victim was a farm labourer, forty years of age, who had eaten mushrooms which had been cooked the night before, kept all night in an enamelled iron dish, and then warmed up again for breakfast. He had then developed symptoms of irritant poisoning, had been sick and very much purged, and had finally become very much collapsed, and after gradually becoming unconscious had died. Also many cases of sickness and diarrhoea had occurred in this district in persons who had eaten largely of mushrooms; these mushrooms being undoubtedly of the variety Agaricus campestris. And for long there was considerable doubt as to whether or not mushroom eating had been the real cause of the epidemic.

The question was not so much that some poisonous fungus had been eaten by mistake, now that some people are affected by mushroons as by an irritant poison. But that mushrooms are cellular organs very apt
to decay, and, when decayed, may become a nidus for the development of microbes. That they may, and do under certain conditions, acquire injurious properties probably by the action of putrefactive bacteria or special bacilli, which elaborate chemical bodies to which their poisonous action may be due. In consequence of their parasitic nature, too, it may be well to consider the locality in which they are gathered; for it may be possible for them to absorb deleterious matters. Indeed, some cases of ordinary sickness occurred amongst children who had eaten mushrooms gathered from a field which, some months before, had been sown with artificial manure in the form of ground bones; and the children belonging to Family B. had also eaten mushrooms gathered from the same field a few days before their illness broke out. But cultures prepared from mushrooms taken from the same source and inoculated into guinea-pigs produced no action whatever, nor did the animal suffer in any way whatever when fed with these articles. By and bye another member of
Family B. fell ill in the same way and no positive proof could be obtained that she had eaten mushrooms at all. Therefore we are justified in looking for some other source of the disease; premising at the same time that the injection of unstable food may, by causing derangement of the digestive system, help to form a nidus some where in the alimentary canal favourable to the growth and development of pathogenic bacteria.

In this case the first patient attacked was the senior member of the family and she, as far as can be gathered, had been in civil health for years. She apparently had not undergone any medical treatment until a few days before she died. But for long had been troubled with attacks of vomiting, occasional attacks of diarrhoea, and other symptoms indicating digestive trouble.

Like so many women she may have been a victim to chronic constipation. A chronic constipation which may have been the real cause of the apparent attacks of diarrhoea. Further she may, indeed, have suffered
from some ulceration of the colon: for there is no doubt that the persistent accumulation of feces can lead to serious mischief, among other evils to piles, ulceration of the colon, and enteritis, and not only so but to actual Malignant Disease. In my own experience, Serous Cancer of the Rectum has developed in elderly people after long years of constipation. If then, any such condition were present how favourable a field we had for the development of Streptococcus pyogenes, or any other accompanying pathogenic micro-organisms. And we can trace from this patient in a definite way through her daughters who nursed her to their children nursed by them, lines of communication connecting this central point of infection with the other points developed in each patient as he or she fell ill — and we can point out also that those children and those other inhabitants of the house, neither directly nor indirectly in touch with the original source of infection — if it were the original source — in no case contracted the disease. Are we not justified
then, in supposing that some such cause wrought the death of the senior patient, that external circumstances favoured the development of accompanying elements in her disease, that exceptional circumstances augmented their virulence and capacity for infecting others, and thus brought about this lamentable and fatal disorder.

**Remarks.**

Diarrhoea may be caused by the injection of food which has undergone putrefactive changes as the result of bacterial activity and some cases of meat and fish poisoning are of this nature. Also diarrhoea may be caused by the growth and development of micro-organisms within the intestinal canal. And when these organisms are once introduced they are capable of developing and multiplying with great rapidity and the toxins formed in the bowel may set up symptoms of a disorder which may rapidly go on from bad to worse and aggravated sometimes as these cases undoubtedly were, by overcrowding, want of light and of ventilation.
May end fatally within a few days.
That form of diarrhoea which is prevalent among children during summer time is of microbial origin, being probably due partly to direct infection and partly to the ingestion of milk and other food containing toxins elaborated by putrefactive organisms.

It will be noticed that of the micro-organisms which are frequently present in intestinal disorders associated with diarrhoea, typhoid and the like, neither the Finkel-Prior Spirillum of Cholera Verae, nor the Bacillus enteritidis of Gartner, nor the Bacillus lactis aerogenes were present.

Undoubtedly the Streptococcus pyogenes was the chief promoter of the disease. That Streptococcus which under some conditions seems to be the originator of erysipelas and then again is present in cases of puerperal sepsis and is closely related to that form of Streptococcus—Streptococcus pyogenes—Streptococcus of lobulations—which is found in connection with cases of scarlet fever. Strange it is that this Streptococcus may exist in the
Intestine without causing any symptoms at all, and then again may acquire a virulence which gives rise to such a violent disorder. It is known that this is the case with other microorganisms too, for even during cholera epidemics virulent bacilli have been isolated from the stools of healthy men. It has been demonstrated that the virulence of a micro-organism can be increased by injecting along with it a quantity of a culture of another micro-organism; and that the virulence of the streptococcus can be increased by being injected along with bacillus coli.

In culture outside the body the streptococcus grows slowly. Bacteria which, under normal conditions, are not present in the bowel may cause morbid symptoms, especially when they are pathogenic to man, and are capable of producing fermentation, and they may act by giving rise to poisons by decomposing the contents of the intestinal canal - e.g. Bacterium aerogenes locini - or they may set up general infection after causing inflammation of the intestinal mucosa.
and destruction of the epithelium. It has already been pointed out that on examination of a section of the hardened colon taken from one of the cases discussed the epithelium was found to be entirely gone.

Streptococci then, do not always give rise to symptoms. They may be found in culture from normal throats, and are frequently present in scrapings from the pre-epithelial ulcers; in both instances their presence apparently giving rise to no symptoms. Under certain conditions, however, which are difficult to understand—though it may be when something occurs to lower the vitality of the individual, at a time when the temperature and surroundings are favourable to the growth and multiplication, and increased activity of the organisms—these virulence become much intensified, as is well shown by the streptococcal invasion of the fauces seen in diphtheria and scarlet fever.

It seems reasonable to suppose, since the streptococcus finds a suitable medium in pus, that pus which is often found in the neighbourhood of carious teeth may form
a point from which the infection of the alimentary canal may start. And it seems reasonable also to suppose that ulcerations, or merely some lowering of the vitality of the tissues lining the alimentary canal, or some deficiency in the natural secretions, e.g., of the bile, may to a great extent allow the micro-organisms to assert themselves, and assert themselves, too, with a much greater vigour than they can do under perfectly healthy and natural conditions. And once the micro-organisms have initiated such a disease as the one we are referring to, unless some considerable amount of care be exercised, it seems that disease, by their agency, can somewhat readily be transferred from one person to another.

Treatment

It is necessary to look carefully into the surrounding sanitary arrangements and cause any defects to be remedied. Adequate ventilation is a matter of great importance. Where possible it is perhaps better to remove the patient or patients from
The locality altogether and place them in an isolation hospital.

All food should be carefully examined and if there is any reason to suspect it, should be destroyed.

All house flies should be as far as possible destroyed as they, as in dysentery, may prove a fruitful source of infection.

Where possible a special and efficient nurse should be procured.

The indications are to relieve pain, maintain the strength of the patient, and guard against the extreme liability to collapse, and so as a way with, or mitigate as much as possible the action of the agent which has established and is keeping up the mischief.

It is well to commence the treatment with a purgative. Day a dose of calomel, or castor oil, and continue the treatment with intestinal antiseptics such as salol, paraffine of bismuth, and the like. The subnitrate of bismuth is good: it has a powerful bactericidal action. When in contact with water it leads to split up into bismuth oxide and nitric acid. In the intestine
It meets with sulphured hydrogen gas, while it converts into black sulphide, more acid is liberated; this is partly transformed into milious vapours and the centripept action of these is great.

Pain, which is such a marked and frequent symptom, must be relieved by opiate. In this case the duct, often giving marked relief, a mixture may be given containing e.g., bismuth, or ammon., etc. combined with the drug. Morph. hydrobrol.

The anaemia appeared to be without beneficial result.

The diet must be bland and unirritating. Duck's perfumed beef juice, and carefully prepared maltine and chicken broth, especially the latter were found to be especially useful. Of great use too, was egg albumen - the whites of two or three eggs being stirred in a pint of water to which a little salt and a teaspoonful of brandy had been added. This was well and readily taken and proved of very great service in maintaining the patient's strength.

Finally the very great importance of irrigating the bowel must not be over.
ooked. — It will be found of great service to irrigate the bowel carefully and gently with weak boric acid solutions. These irrigations were used at least once every twenty-four hours in the cases which recovered, and seemed to have a marked influence not only in giving relief, but also in subduing the virulence of the disease.