Thesis for M.D.

On Bacteria found in the Human Intestine

by

James Arltum, M. B., Ch. B. (Edin.)
On Bacteria found in the
Human Intestine

The bacteriological conditions existing in the human intestine in the various stages of life, in health and disease, is a most fascinating, as well as an educational one. For the purpose of this thesis I propose to give the results of investigations and state the views held by many workers in this field of research.

If meconium taken from a child at birth is examined it will be found to be sterile; on the other hand, if ordinary feces are examined, they will be found to be teeming with microorganisms.

Though the intestinal tract at birth is sterile, it is impossible in ordinary conditions of life for it to remain so. From the time the child first opens its mouth, bacteria gain an entrance and find their way into the digestive tract.

They are found so soon in the feces that it is of opinion that they enter by way of the anus, from the external air.

Be that as it may, it is not long before the intestinal tract swarms with bacteria, and it may be interesting to investigate the various parts of
the intestinal Canal inhabited by bacteria.

**Disturbance of Bacteria.**

In the mouth both Aerobic & Anaerobic organisms are present.

In the stomach anaerobes are few owing to the action of the gastric juice & the absence of air; but where there are large masses of food, & especially hydrochloric acid, they may develop. Due to fermentation & putrefactive changes. One thus see that the gastric juice has a protective action by covering the vitality of organisms which are injurious to health.

In the duodenum & jejunum we find the fewest number of bacteria, due to the proteolytic action of the pepsin ferment & trypsin enzymes. Cushing & Livingstone ("Contributions to the Science of Medicine from the Pupils of William Welch" 1900. p. 443) found that in gunshot wounds of this part of the intestine, the bacteria which escaped into the peritoneum did little or no harm.

In the ileum we find bacteria increasing in numbers, but in the region of the ileocecal valve they are more numerous than in any other part of the small intestine.
In the large intestine we find the most dense accumulation of bacteria, the best conditions for the growth of anaerobic organisms, and it is here that we find the most pronounced evidence of putrefaction. There is a gradual fall in the number of living bacteria throughout the caecum and colon, till they are comparatively few in the rectum.

About two thirds of the weight of fecal matter is composed of bacteria, according to Cohnenzy, the majority of which are dead.

One hundred and twenty six billions are said to be excreted per day! In the lower part of the bowel they undergo a process of disintegration, partly "slowing in their own juice," in other words, a process of autolysis.

As the digestive tract is so rich in micro-organisms in health at all ages, the question arises, what are they for? Pasteur was one of the first to make enquiries on this point, he expressed the opinion that these bacterial inhabitants are necessary to the life of the individual that harbors them.

Are bacteria necessary in the process of digestion?

There is some conflicting evidence on this point.
Lattell & Trenkler ("Zeitschr. für Physiol."
Chem. 1895, XXI, p. 109; 1896, XXII, p. 62; 1897, XXIII, p. 231.) performed some interesting experiments.
After delivering young guinea-pigs by Caesarean section and keeping them for some days under sterile conditions, they found that they
bloomed well, & on being killed, the intestinal tract was found to be entirely free from bacteria.
They proved thereby, that in the case of the
guinea pig at any rate, intestinal bacteria are
not essential to normal nutrition & well being.
This view is supported by the observations of
Levin ("Skandinavische Archiv f. Physiol." 1904, XVI, p. 249.) who examined the intestinal contents
of Arctic animals at Spitzbergen, including
bears, seals, reindeer, ducks, pelicans etc. &
found that except in these instances they were
all sterile.
On the other hand Schottelius ("Münchener.
med. Wochenbl." 1898, no. 36.) experimenting
with chickens; Madame Melchiorff with tadpoles,
("Ann. de l'Inst. Pasteur." 1901, XV, p. 361) & hares
with the Cars or lizards, came to the same
conclusion, viz., that intestinal bacteria are
necessary to normal nutrition.
It goes without saying that experiments conducted on animals do not carry the same weight with regard to human conditions, as experiments conducted on man himself. In connection with the question under discussion I think the following experiment outweighs the former ones already described.

MacFarlane ("Diseases, Seventh International Congress of Hygiene." 1892. p 80.) describes some researches made by himself and others at Bern. They had a case which had been operated on for intestinal obstruction, and artificial anus had been made in the ileum just above the ileo-caecal valve. This condition remained for six months during which time the large intestine was of course completely shut off. During this period they studied the bacteriologic conditions of the feces and the effect of varied diet on the intestinal flora.

They conclude that bacteria are unnecessary in man for the process of digestion. The decomposition of food in the small intestine is limited to carbohydrates, and the products (succinic, laetic and lactic acids) formed cannot be regarded as necessary to life. Further, any marked decomposition of proteins first takes place
in the Large Intestine. This portion of the digestive tract was in the patient shut off from any participation in the process of digestion, without the least detriment to health.

This, therefore, is strong evidence in favour of the theory that bacteria are not necessary to normal nutrition.

The Defensive Action of Intestinal Bacteria:
Preceding the most important function of the normal intestinal flora is not-connected with digestion, but is that of defending the host against what have been termed the "wild races" of bacteria which have escaped the action of the digestive juices. These normal inhabitants of the intestine are necessary to bacterial flora which cannot be excluded from the intestinal tract.

We may now proceed to examine in more detail the various bacteria found in the intestine. Martin, ("The Lancet," Vol. II. 1909, p.1216) divides them into three groups. —(1) Endogenous, e.g. B. Coli; (2) Exogenous, e.g. B. Typhosa; (3) Pathogenic. I propose therefore to describe first, the normal intestinal flora.

Second: The Exogenous, or Pathogenic bacteria.

To conclude with some remarks on Bacterio Therapy.
I. The Intestinal Flora. (Endogenous)

Certain differences exist in the varieties of bacteria present in the intestine during the periods of childhood, adolescence, and senescence.

1. In childhood, Rossin (Ann. de l'Inst. Pasteur, Paris, Feb. 25, 1905) states that in the intestines of nurslings, bacteria which are few in the stomach are still fewer in the duodenum and jejunum, but progressively increase in the ileum, cecum, and rectum where they reach their greatest number. Taking the bacteria found in the intestine from stomach to rectum, the following is their order: — B. Lactic; B. Coli; Enterococcus; B. Erys; B. Acidophilus; B. Bifidus.

In the stomach the organisms are aerobic, non-fermentative, whereas they become anaerobic lower down, until in the rectum they are strictly so. Their fermentative action causes proportionately the distillation of these bacteria in determined chiefly by three causes: (a) the sterilising action of the duodenal secretions; (b) the oxidising action, more or less pronounced of the intestinal contents; (c) the varying fermentative powers of the bacteria.

The bacterial flora in the nursling is only
bacterially numerous as regards variety, & the bacteria are concentrated in the regions that lie between the colon ileum & the anus. There is a marked diminution of living bacteria in the colon, due partly to autolysis, but mainly due to diminution of food & lack of moisture.

In bottle fed infants the number of bacteria found present in the digestive tract is considerably greater than in the case of the breastfed, & this is only to be expected when one considers the number of micro-organisms present in breast specimens of cow's milk, which apart from specific organisms like St. typhosus etc, contain Streptococci & putrefactive anaerobes.

The flora in the whole is the same as in the breastfed, but whereas in breast-fed infants B. Bifidus is the predominating organism in the large intestine, in bottle fed children B. Coli takes its place. Streptococcus Faecalis (K Known. Centr. f. Bact., XV, P. 737, 1903) is almost always present. Also various diplococci, B. Cloace, a gas forming bacillus of B. Aerogen Capsulatus.

2. In Adolescence. Normally, most of the above organisms are present, but B. Bifidus is not so numerous & there is a greater number of putrefactive organisms.
3. In adult life. At this period there is a greater difference in the habits of persons than in earlier ages. People live at greater stress; there are more variation in diet; they indulge in tea, coffee, alcohol, tobacco, often to excess; their life is often more sedentary than before; they have more worry. It is also at this period that we find increased putrefactive processes in the intestine. B. aerogenes Capsulatus and B. putrifaciens may be abundant.

4. In senescence the ordinary obligate bacteria are present, but their activity is diminished. B. coli may still be so numerous and B. aerogenes Capsulatus and B. putrifaciens are more numerous.

It is therefore clear that there are distinct differences between childhood and old age, the former being a tendency towards increasing putrefactive changes. Metchnikoff has often advanced the theory that old age is due to intestinal infection, probably due to putrefactive organisms. The intestinal bacteria may be divided into two classes—(a) proteolytic, which act on proteins and produce putrefactive and toxic products and (b) amylolytic, which act on hydrocarbons. The products of the latter variety are less toxic, and some tend to check nitrogenous putrefaction. The amylolytic organisms
are found chiefly in the small intestine, the protolytic in the large. (Gabiński.)

The chief products formed by the protolytic organisms acting on undigested residues are hydrocyanic acid, succin, succinic, glycin, carbonated sulphide, hydrogen, indol, skatol, cresol, etc. (Bouche). Some of these products are converted into ethereal sulphides which appear in the urine. By their presence one can measure the amount of intestinal fermentation.

Influence of food on the intestinal flora.

Not very much is known on this subject, but some interesting observations have been made. With a meat diet (i.e. raw meat) Gram-positive organisms, a good many of which are patho-lytic bacteria, are the predominant ones. It is true, whereas in herbivorous animals Gram-negative are most numerous, Escherichia coli is often present in the young dog whose skin-bacteria flora was very similar to that of normal burslings, that after a pure meat diet the color bacilli were greatly diminished, whereas there appeared large numbers of liquefying colonies. Lembke, (Archiv f. Hyg. XXX, p. 525. 1896) experimented on dogs with meat, fat, or bread diets. Curiously enough, he found that a bread diet rendered the feces much richer in ameboids than did a diet of meat. The changes induced by alteration of diet were generally
of a transitory nature. He says: "If the diet is changed, there appear on the focal plates new colonies of the most varied sort. In the course of a few days these are materially reduced; the colonies of B. Coli again gain the upper hand."

It may be of interest to study in more detail the chief obligate bacteria of the human intestine viz.: B. Coli Aerogenes, B. Coli, and B. Infides.

B. Coli Aerogenes.

This bacillus is found most abundantly in the upper part of the small intestine, diminishing in number till in the colon there are very few, or usually none at all.

There is a close resemblance between this organism and B. Coli; the morphological differences are very slight, but the biochemical characters show several differences. It seems to require prior presence of milk sugar, hence its absence from that part of the intestine where milk sugar is not found. (Holl. "Diseases of Infancy and Childhood," 1902, p. 322.)

B. Coli from gas more readily on sugar media than B. Coli; Coagulatus with more readily (often with capsule formation); evolves gas from potato starch, grows more luxuriantly on gelatine; there is a more frequent failure to make indole.
B. lactis has greater fermentation powers than B. coli
but less putrefactive powers.

Harden states ("The Chemical Action on Glucose of
the Lactic fermenting organisms of Juices," Journ. of
Agr. V. 1905, P 488.) that there is a constant
difference in the action of B. lactis and B. coli, when
grown anaerobically on sugar bouillon, in regard
to the ratio of alcohol to acetic acid produced.

The chief physiological action of B. lactis,
as before mentioned, is its action on milk and sugar.
This it decomposes, with formation of lactic acid,
acetic acid, (Begunsky) carbon dioxide, hydrogen,
or methane. This action is lost hindered by the bile.

The B. lactis has no action of importance on either
the milk or Casein of the milk.

Virulence of B. lactis.

Little is known on this subject.
It is believed not to be pathogenic, but in case of intestinal fermentation, e.g. when ripe fruit juice has been
taken, it may aid in the fermentation process.
**The Bacillus Coli Communis**

This bacillus was first isolated from human feces by Escherich ("Deutsche Med. Wochenschrift" 1885, No. 2.) It is interesting to note that he then thought it was the cause of Asiatic Cholera.

Its characteristics are well given in:
- M. Escherich and G. Prinziper "Bacterium Coli Communis"

The Bacillus Coli is one of the obligate bacilli; is gram-negative, and in all probability the most important microorganism found in the intestinal canal. It is regarded as a normal inhabitant of the large intestine, and is to be found there in large numbers, except in certain pathologic conditions.

In appearance it is a short rod, closely resembling to typhoid fever bacilli, due to cilia which may be single or double, but not so long or wavv as those possessed by the latter bacillus. It produces thermostable and thermodabile substances (Conrad and Kupferscheit, "Kurze der Beratung der bakteriellen Hemmungsstoffe für die
Bacteriologie Physiologie und Pathologie des Darms."
which have a powerful antibiotic action even in a dilution of 1 to 10,000; it is their action
that accounts for the large number of alien bacteria
found in the large intestine. These substances are also
capable of destroying the B. Coli itself (autolysis).

The members of the B. Coli group are organisms
characterized by varying morphology; hardy growth
on ordinary media; free production of gas from
sugar; coagulation of bile; usually form
mucoid. The fully grown forms have slightly
motility, but younger groups are more actively
motile. They have an inhibitory action on putrefactive
anaerobes.

The chief cultural characteristics of the B. Coli
are as follows — 1. Incubated on agar at 37° C for
24 hours, the colonies formed viewed by transmitted
light are denser and more glistening than those
of B. Typhosa, T are of a bronchial white color.
2. On gelatin agar, the appearance are the
same as in the case of B. Typhosa, but the growth
is firmer, thicker, more opaque.
3. A potato culture in 48 hours shows a bronchial
film of growth which rapidly spreads. It becomes
Chicken, thus differing from a culture of B. Typhosus which forms a colourless film.

Bacillus Coli or the Coagulation of Milk.

In connection with this important function of B. coli, an interesting paper is Communication by Savage "Journal of Path. & Bact." Vol. 7, 1905. p. 76.

His conclusions are as follows.

1. Curdling of milk by B. coli is due in almost all cases to the formation of acid—presumably lactic acid—by the bacteria.

2. Milk B. coli which curdles only after some days, lactic acid in curdling is due to diminished production of acid.

3. Only in a very few doubtful cases can the curdling be ascribed to an enzyme.

4. An enzyme is present in B. coli, obtained from many varied sources when grown in milk media, but in general it plays no part in the initial curdling, coming into action subsequently, converting soluble caseinogen into insoluble casein.

The morphological resemblance between B. coli and B. Typhosus is so close that it is important to enumerate their chief distinguishing cultural characters.
Vivien of B. Coli.

Since its first description by Escherich, considerable change has taken place in the view currently held with regard to the role that the above organism is supposed to play in human clinical pathology.

Escherich himself, although he had shown that the bacillus could produce a fatal toxaemia in animals, was of the opinion that it was quite harmless to man. Before long, however, evidence began to accumulate to show that the organism was widely disseminated and pathogenic properties.

Since Javelly first reported a case of infection of a Latvia wound by B. coli ("T. M. J." 1897, Vol. II. p. 187) up to the present time, an extensive and formidable list of pathological conditions have been traced to B. coli.

In 1897, Krutz first described a case in "Archiv. de Médecine Experimenterale" cases in which the presence of B. coli to be the causative organism. This list includes: (1) Cholecystitis, Operative Membranous Colitis, and other intestinal lesions; (2) peritonitis; (3) angioneuritis, Cholecystitis; (4) cystitis; (5) various pulmonary affections; (6) Endocarditis, meningitis; (7) arthritis. Since then many
...more conditions have been added to the list.

Indeed, there are few phyogenic conditions at the present time which B. coli may not be found.

It is capable of producing powerful toxins, as has been shown by many observers including Carreña ("Über die aktiven Substanzen des B. Coli"
Centralbl. für Bakter. Aug. 1903.)

in these phyogenic troubles, some of the symptoms are due

to these toxins.

Can the B. coli produce an actual septicaemia

as distinct from septicemia? This is a point that
is not quite decided yet. There are many difficulties
in the way. Post-mortem findings are discounted
by the difference of opinion held by bacteriologists
as to whether the B. coli may invade the body
during life from the intestine or not. There are
three opinions. (1) In earlier views, that it may pass
post-mortem, viz: after that it multiplies with
extraordinary rapidity after death, or penetrating
from the alimentary canal, may be found in vital
organs, such as the brain, heart, within a few hours
of death. (Coats "Manual of Pathology" 4th Ed. 1900.)
(2) That the organisms first gain entrance to the
body during the so-called agonial period

which immediately precedes death.
3. That the B. coli may invade the body during life either through healthy or diseased intestines, and either itself producing a Septicaemia, modify the course of a previously existing Septicaemia, or prepare the way for a Septicaemia to be caused by some other organism.

It would seem therefore that the most reliable cases are those in which the B. coli has been found in the blood during life. There are some cases recorded which would seem to prove the last mentioned theory. From reported by König in "Anschauungen über Endocarditis," deaths resulted from septic ulceration of the aortic valves. During life the coli bacillus was isolated from the blood during the early stages of the disease, in pure culture. While Colet in Streptococi were also found. Sivadej, in Zeigler's Centralb. der Path. in "Klin. Therap. Fortschrifft," 1901 reports a case of general infection during an attack of influenza. Nordwiski also in "Archiv für Klin. Med." Bd. 52. Hef. 3. 1894, records a case of general B. coli Septicaemia following a local urethral infection. In all these cases
the B. coli was found in the blood during life.

In experiments on animals, it has been found by various observers that a mixed infection with B. coli was much more virulent than pure one of that organism, harmless by itself, became virulent when mixed with B. coli. (Truax & Besançon, "Revue Française de Vétérin," 1894.)

Sims Hoodhead ("The Lancet," 1896, Vol.5, p.982) said that he believed that many so-called septicaemic infections were really secondary to colonic infections.

If a virulent culture of B. coli be injected into a vein of an animal it produces a rapid septicaemia, with haemorrhages in various organs. If however the virulence is not sufficient to kill, atrophy of the anterior cornual cells takes place; causing hypoplasia, then paralysis and atrophy of the muscles.

Although the evidence of the existence of B. coli septicaemia in man is not whole, slight, Gillman Moorhead thinks it exists and quotes a case in favour ("The Practitioner," Vol. LIXIV, p.776). He thinks that possibly its existence in some cases accounts for the inefficacy of anti-streptococcic
Is the B. Culi Capable of becoming pathogenic as long as it is confined to the intestine?

In the early days of bacteriology, many pathogenic conditions were placed to the account of B. Culi without sufficient evidence. For example, many cases of diarrhea said to be caused by B. Culi, were ultimately found to be due to B. Dysenteriae. Even B. Typhosa was confounded with it.

Dr. Harland in his Text-book of Pathogenic Bacteria, p. 574, says that in infants "Cholera Infantis" may not infrequently be caused by B. Culi, though he qualifies this remark by stating that probably in this disease, other bacteria play an important role.

Cunston, "International Med. Magazine," Feb. 1897, made a careful study of Summer diarrhoea in infants and came to the following conclusions:

(a) B. Culi seems to be the pathogenic agent in the greater number of cases of Summer diarrhoea.
(b) The organism is often associated with Stripped or pneumogens. (c) The virulence is almost always in direct relation to the condition of the child at the time the culture is taken. (d) The virulence of B. Culi is in general, proportionate to its virulence.

It is probable that in these cases B. Culi causes
on a virulent action through being a mixed infection.

Lesage ("La Semaine Médicale," Oct. 20, 1897)

stated fifty cases of colitis in infants, due to

B. coli. He found in forty of these cases that the

blood of the patient agglutinated the cultures

obtained, not only from his own stools, but from

those of all the other cases. It is also interesting
to note that he found that the agglutinating action

only occurs in the early stages of acute forms of the

disease.

Sir A. H. Wright has described cases of various

colitis which were most dramatic and extreme, which

were cured by vaccines of B. coli, and thinks that

they were due to B. coli infection.

Such evidence as this alone, supporting that the

organism was real typical colon bacilli, is in favor

of the theory that the B. coli may cause acute diseases

of the intestine.

On the other hand, there seems to be plenty of evidence

that in chronic disorders, where putrefactive

decomplications occur; but even in these cases there must

be putrefactive organisms present, because the members

of the coli group cannot initiate active putrefaction

of nature permits.
Bacillus Bifidus.

This was first described by Visier. ("La Flore intestinale normale et pathologique du nourrisson." Thèse de Paris, 1900)

It is a slender Gram-positive bacillus of moderate length & thickness, usually with a bifurcated extremity, hence its name. It may occur in three forms, a plain bacillary form, a bifid form, & a clefted (knobbed) form. It is closely related to B. Coli & was grouped with it by Escherich before Visier's investigations. It is an acidophile & under certain conditions inhibits the growth of some of the anaerobic organisms such as B. aerogenes, Capsulatus of Welch.

In this respect also resembling B. Coli.

As has been mentioned before, it is found chiefly in the intestine of nurslings but usually disappears by the fourth year.

Renter however states that in certain cases of infantile diarrhea there is a persistence of the flora of the nursing period. In these cases he found in abundance B. Bifidus & an allied organism which he calls B. Infantis.
II. Pathogenic Bacteria found in
the Human Intestine.

Having discussed the normal intestinal flora, we may now turn our attention to some of the bacteria which are habitant to man which are found in the intestine in pathological conditions of which they are the cause. To describe all the bacteria which are responsible for discussed conditions of the intestine is outside the scope of this work.

The most important group of pathogenic bacteria of the intestine is the Coli-typhoid group which includes:

1. B. Coli.
2. B. Typhosus.
3. The Paratyphoid group of organisms.

All these organisms are linked together by most intimate affinities, & in the early days of bacteriology were often confused. Many forms of diarrhoea which are undoubtedly due to B. Dysenteric were thought to be caused by B. Coli; even B. Typhosus was confounded with the Salmon bacillus. Thanks however to the progress made in methods of identification, the differences between the various members of this group have been more sharply defined. & though there
is still plenty of work to be done in this respect, we know fairly well the effects and limitations of each organism.

In any case, each organism separately.

1. **B. Coli.**

This bacillus has been already studied (supp.13-21) both as a normal inhabitant of the intestinal tract, as a pathogenic agent. At the present time there is very little evidence of any weight against *B. Coli* as a cause of pathogenic conditions of the intestine per se, so it will be interesting to see in the future whether such evidence will accumulate. The tendency has been for it to assume a less pathogenic rather than a pathogenic role as an inhabitant of the intestine. Will this continue?

2. **Bacillus Typhosus.**

This bacillus was discovered by Eberth ("Vierhows Archiv. 1881-1883") and first secured in pure culture by Gaffky. ("Mittheilungen aus dem Kaiserl. Gesund."")

I do not propose to give detailed descriptions of these bacilli and their cultural and biochemical characters. These are well known, and will be found in any text-books of bacteriology.

This bacillus is closely affiliated to the *Coli* bacillus, but differs from it in important biochemical properties. It is much more pathogenic to man. What relation it bears to the *B. Coli* in the long process of evolution we do not at present know.
The evidence of the intermediate bacilli—paratyphoid and paracolonic—is well established, and the fact that there are transitional forms is suggestive of a descent from a common ancestor.

Lorrain Smith ("Lancet," Dec. 16th, 1905) reviewing the results of recent investigations on the various forms of disease associated with the Coli-typhoid group, came to the conclusion that in each case the disease forms a clinical unity, while the bacilli producing it might belong to more than one type. This conclusion applied to typhoid fever, dysentary, meat-poisoning cases associated with Gärtner bacilli, and Coli infections.

The usual portal of infection in typhoid is the digestive tract, but the bacilli may gain an entrance by the throat. While the bacillus has its primary seat of action in the lymphatic tissues of the intestines, the fever is very largely due to its growth in the internal organs. As Macleod very well puts it, the action is dual, one a local specific action of the parasite on the glands of the intestine, and a general action of the organism on the blood and tissues. A single bacillus, as he says, in ten days might produce a billion, and the incubation represents the period during which the bacilli are being
reproduced. (Osler's "Principles and Practice of Medicine" 1904, p. 7.) In proof of this it may be noted that B. Typhosus has been demonstrated in feces during the incubation period by Conradi, "Klin. Jahrbd.," Bd. XVIII; Meyer, "Centr. f. Bakt.," IV, 1910, p. 234; and Simon, "Klin. Jahrbd.," Bd. XVII.

Not only can the bacilli be found in the stools during the incubation period, but there is evidence to show that these cases can infect others. Klinger, in the "Journal of the R. A. M. C." Jan. 1910 describes an epidemic in which, out of 812 Cases of typhus in which contact infection was proved, 183 had been infected by subjects in the incubation period.

B. Typhosus can be cultivated from the blood during the first week of the illness in over ninety per cent of cases, and this fact explains many of the complications - sequelae of the disease - enlargement of the spleen, cholecystitis, bacillary peritonitis, etc. (Coleman & Buxton)

There seems little doubt that the organisms enter the blood via the general system via the intestine. Can they enter through an absolutely intact wall? Cases have been described (Pick, Clebsch, etc.) where after careful search, no epithelial lesions could be found, but as Clebsch says, they may have been overlooked, or slight lesions may have healed.
Galen also states ("Practice of Medicine," p. 7) that there is no conclusive evidence that typhoid bacilli can ever enter the body except through the intestinal tract. This is rather a sweeping statement to make, for there are one or two cases recorded which would seem to negate it, though the proof is not substantiated enough.

Henry V. Rosecrans ("Amer. Jour. of Med. Science," 1898) found in a case of meningitis, that with the blood and cerebro spinal fluid obtained by lumbar puncture gave cultures of B. typhosus. There were none of the usual symptoms of typhoid present. They considered it a case of primary lesion due to B. typhosus.

Lawson ("Proc. of Pennsylvania Med. Bull.," April, 1908) records another case, which gave all the symptoms of meningitis. On the 8th day of the illness the blood gave a positive Weil's reaction. At the post-mortem absolutely no sign of any intestinal lesion was found, but there was a purulent meningitis caused by B. typhosus. He thinks this is a case of primary meningitis, that the infection was an aerial one by way of the nasal passages.

One curious factor in regard to the B. typhosus is the fact that it may be recovered from the urine and stools of persons who had suffered from the disease for some very considerable time after the attack.

Dean ("British med. Jour," March 7th 1908) records
the Case of a medical man in which, twenty nine years after an attack of typhoid, could still be isolated from the stools, Gregg (quoting in "Amer. Jour. Med. Science" Aug. 1, 1908) reports a case in which the interval was forty nine years. Many more instances might be quoted. These persons who harbour B. typhos in their stools are called "Carriers," the Germans divide them into "acute" and "chronic carriers" according to the length of time they harbour the bacilli. Many relapses of the disease have been traced to these carriers, and the problem of dealing with such cases is occupying the attention of many workers at the present time.

It is a well known fact that the gall bladder is a favourite habitat of the B. typhosum. Caufield ("Ball. of John Hopkins Hosp."

Tr., 1906) invariably found in the bile in typhoid, clumps of B. typhosum resembling the application of the Widal reaction. He thinks these clumps probably from nuclei upon which the bile salts are precipitated. Calculus formation is begun, of course gall stones are very common sequela in persons who have suffered from typhoid, and typhoid bacilli have been found in gall stones removed at operation. Caufield mentions six cases. Sometimes B. coli and other organisms of the group are found in cases of cholelithiasis. Blumenthal made an
Interesting study of fourteen cases of cholera infantum, the result of which is recorded in "Deutsches Archiv für Klin. Med." Leipzig, 1907, be 88. In ten of the cases he found organisms of the 
Eberth's group, the other four were sterile. In four of the ten he found B. coli; B. leptopersuis in
four; B. paratyphus A in one; and a modified B. coli in another. He thinks the presence of B. coli is often accidental. That the importance of it in the causation of inflammation of the gall bladder has been overstated, and that of B. leptopersuis underestimated.

The Kidal reaction, or application test, is greatly
used in the diagnosis of typhoid fever, and few remarks
on it may not be out of place.

It was first discovered by Kidal & Greenbaum
working independently, in 1876 ("La Semaine Médicale," 1876, p. 294) If the serum from a patient suffering
from typhoid be added to a culture of typhoid bacilli,
the culture forms in clumps of one with certainty.

Stengel & Kreass ("Amer. Year Book of Med. 
Surg." 1908) collected and tabulated nearly 4,000 cases, and found that
96.5% of the typhoid cases gave the reaction; 98.4% of non-typhoid cases gave no reaction; in other words
the results were correct in 96.5%; incorrect in 3.5%.

There are several fallacies in connection with
the Kidal reaction which detract somewhat-
from its action as a diagnostic measure thus as follows:

1. Infection with allied organisms (e.g. B. paratyphos B) may cause the serum to clump B. typhosus.

In general, the casual organism is the one which is clumped in the highest dilution by the patient's serum; but this is not invariably the case, and it has been repeatedly found that the serum from near-poisoning cases infected with B. enteritidis Parallel clumped the B. typhosus in higher dilutions than the casual organism.

2. The agglutinating reaction does not usually appear for seven days from the onset; sometimes later, in some cases not until the convalescent stage is reached. Conrad ("Deutsch. med. Wochenschr." 60th Oct. 1907) has shown that in 85 cases of contact infection, 60% were contracted during the first week of the illness. Therefore it does not do to rely too much on the Widal test for diagnostic purposes.

3. A patient's serum may acquire the power of agglutinating B. typhosus during an infection which is in no way related to it. Wilson ("Brit. med. Jour." 25th Sept. 1907) has found that the serum of typhus fever cases gives a positive reaction with B. typhosus.

The presence of B. typhosus in the blood & stools is therefore a much more trustworthy method of
Diagnosis than the Kjeltest. For this connection Rémy ("Ann. de l'Inst. Pasteur." Aug. 1903) says that he believes the constant presence of the typhoid bacillus in the stools in cases of typhoid fever, its absence from them in other conditions is a far more important and valuable method of diagnosis than even the Kjeltest reaction.

Antityphoid serum vaccine will be considered under Bacteriotherapy.

3. The Paratyphoid and Allied Bacteria.
The importance of this group was first thoroughly studied by Prof. Theobald Smith ("Centralb. f. Bakt." VII, 1890, P. 504; XI, 1892, P. 367.) By means of careful biochemical studies, agglutination reactions, etc., a large group of pathogenic bacteria have been discovered.
The group includes:
1. B. Paratyphosus A + B isolated from patients. Conditions like
2. B. Paracola.
3. B. Enteritidis (Gärtn. isolated in meat-poisoning cases.
4. B. Bactharia, also found in meat-poisoning.
5. B. Salmophila (Salmon's B. of Hog Cholera)
6. B. Peritacosis, occurring in diseases of parasites.
7. B. Typhli Murium, isolated by Gëfther in Epidemic Enteritis in mice
8. Danyszi Bacillus, also pathogenic to mice.
The pathological effects produced by these organisms include general septicemic manifestations on one hand, & gastro-enteritis on the other.

Many of these bacteria are the cause of animal diseases, but some are pathogenic for man especially the following:—

B. Paratyphoides.

Of late years many cases of fever running a course like that of typhoid, but as a rule milder, have been put down to the cause of B. paratyphoides.

The first cases were described by Achard & Bensaude in 1896. In these two cases the paratyphoid bacillus was isolated, in one from the urine, & in the other from pus in the right sternoclavicular joint.

Grown to agglutinative & cultural differences, the bacillus has been divided into two groups A & B. of the latter group appears to be widely distributed.

Clinically, the B. paratyphoid B has the same effect as B. typhoid. Its agglutinates in highly dilute sera then differing from the latter which requires a low dilution.

Yates ("The Lancet," Vol I, 1907, p. 1571.) records two cases, a mother & daughter living together, in which the disease was at first thought to be typhoid, but in both cases agglutination tests were positive with
B. *paratyphus* B, negative with B. *typhosus*, & B. *paratyphosus* A.

Though *paratyphoid* fever is usually sporadic it would seem that it may occur epidemically. 

Arkin in *Journ. American Med. Assn.* Mar. 19, 1910 describes an epidemic of thirty-five cases clinically resembling typhoid. The blood-serum of sixteen of these cases which were tested reacted positively with B. *paratyphus* B, but not with B. *typhosus*.

J. A. Bambridge (*The Lancet* Vol. II, 1910, p. 556) describes an outbreak of acute enteritis with pyrexia lasting several days. All the cases recovered but convalescence was prolonged. In the stools of some of the patients B. *paratyphus* B was found, while the blood-serum of six of the fourteen cases clumped this bacillus.

An outbreak of *florum* poisoning occurred at Exeter in 1910, affecting 107 persons, with five deaths.

The outbreak was caused by the consumption of pork pies, which were found to contain the B. *paratyphosus* B. Several cases gave agglutination tests with this bacillus, & it was cultivated from blood taken from the heart of one of the fatal cases. Three persons nursing this fatal case caught the disease by contact & one died.
The cause of the outbreak was traced to a "Carrie", one of the confectioner's staff, who made the pies. The bacillus was isolated and cultivated from this person who was, as usual in "Carrie" cases, in perfect health.

_B. Parkalis_ Alkaligenes.

This is another of the color group of organisms. It was first isolated from feces by Petruschky ("Centralbl. für Bakter. u. Parasiten." 1907, p. 187). It causes fever which is clinically inseparable from mild forms of typhoid. Its cultures are not agglutinated by typhoid serum.

_B. Eutectidii (Gärtn.)_

This bacillus was first described by Gärtn. ("Korrespond. d. Allg. ärztl. Ver. von Thüringen," 1888, no. 9) who cultivated it from the flesh of a cow killed because of an intestinal disease, and from the spleen of a man poisoned by eating meat obtained from it.

It is found in diseased meat. It causes gastro-enteritis in twenty-four hours, but in some cases the effects are immediate, probably due to the presence of a large quantity of toxin. It produces an haemorrhagic enteritis usually a septicemia with inflammation of serous membranes.

Parson ("Lancet" Feb. 1905, p. 490) describes two cases of continued fever lasting for fourteen days.
In some respects like typhoid. On many occasions however, the serum was negative to the Klee test, but gave very definite clumping with Gortner bacillus. Cultures were made from the urine and feces but B. enteritidis was not isolated.

Another organism of the paratyphoid group, one which resembles in some respects B. aerogenes capsulatus is the Bacillus Bostoniae.

This organism was discovered by Van Ermengem in 1896 ("Centralbl. f. Bakt. u. Parasitenk." XIX, p. 449). He isolated it from a sample of ham, which eaten raw, had caused an outbreak of poisoning. It acts like the letamin bacillus, by causing a toxaemia, the toxin being absorbed from the intestine and acting on the central nervous system for the bad part.

This particular form of toxaemia is termed Bostonia. The symptoms include paralysis of the eye muscles, ptosis, myasthenia, paralysis of accommodation etc. Then swelling and paralysis of the tongue, pharyngeal and carpygeal paralysis, disturbances of the heart-respiration. Usually there is no cause action on the alimentary canal.

Van Ermengem points out that meat may be extensively contaminated with this bacillus & relatively large quantities of its toxin, without any ordinary signs.
of decomposition being present. The production of an extracellular toxin by this organism is of an extremely potent action on the nervous system is a fact of great scientific interest and has a bearing on the etiology of other obscure nervous affections.

4. Bacillus Dysenteriae

This bacillus was confused with the B. coli until Shiga differentiated it in 1894 ("Centralb. f. Bakter. u. Parasitikhe." 1894, XXXIV, nos. 22-24) and is now known to be the cause of wide spread intestinal disorders of tropical climates which are grouped under the term dysentery, including true bacillary dysentery.

The organism was shown to have different characteristics in different parts of the globe. Flexner, investigating an outbreak in Manila, found an organism allied to Shiga's, but differing from it in that it fails to produce typical dysentery, including bacillary dysentery. Flexner confirmed the opinion that other varieties of the bacillus which were identified with Shiga's. ("Annals of the Pennsylvania Medical Society," 1901)

There are said to be five groups of bacilli found in dysentery (Shiga & Flexner) and they resemble the typhoid bacilli in being hemolytic; that is, their virulent destructive properties are only developed...
When they have been introduced into the intestine in considerable numbers, or have had an opportunity of multiplying due to feeble powers of resistance on the part of the individual.

Chu ("The Phillips Journal of Science. Vol. 5, No. 9, 1906") found in Manila fifteen varieties of the dysentery bacillus all shedding into one another but distinguished by fermentation, agglutination, and other tests.

1. Dysentery has been found to be the cause of Summer Diarrhoea in Infants, especially in America. Evans & Bassett ("American Medicine." Feb. 13th, 1902, p. 417.) found it especially when such diarrhoeas were epidemic.

Summ ("Archiv. Pediat." Oct. 1905) investigated an epidemic & found it to be the cause of most of the infectious cases.

J. E. Allory ("Jour. Perin. Med." N.Y. 1906, Vol. 77, No. 4) studied over 100 cultures from twenty-two cases of Summer Diarrhoea. It is shown that bacilli resembling the dysentery organism may be recovered from even the mildest cases of Summer Diarrhoea. He divided the bacilli found into two groups:

(a) the dysentery group giving typical reaction, & the
(b) pseudo-dysentery group giving atypical reaction.
The points of resemblance indicate a general or family relationship, which may be compared to that existing between the true and pseudo-aphthæria groups. The pseudo forms may be, and perhaps in some cases have been mistaken for the true dysentery bacilli, but are probably devoid of active pathogenic properties.

It is worthy of note that the dysentery bacillus in its affinant varieties resembles the lymphoid and paralymphoid organisms in one very important manner, viz. that the severe forms of disease are dependent on the bacteria further removed from the colon bacillus in their biochemical characteristics. In the first group, Shepa's bacillus, and in the latter, the lymphoid bacillus.

In an interesting paper on tropical dysentery by Capt. Blackham, R.A.M.C. in the "Lancet" Vol II 1906, p. 1499, he comes to the following conclusions:

1. That, notwithstanding slight cultural differences, the various strains of B. dysenterei isolated by Shepa, Flexner, Krebs, Vaillard, Harris, etc., are simply varieties of the same organism. In addition to these pathogenic strains there are several strains which are non-pathogenic. Whether the latter represent degraded or transitional forms of the true bacillus he cannot say.
2. The specific agglutination reaction with the serum of persons suffering from acute dysentery can generally be obtained within two weeks following onset.

He maintains that the clinical entities which we have hitherto termed dysentery, are not one disease, but a group of maladies of varying degrees of severity, ranging from acute dysentery as found in India, to the simple infective diarrhea occurring in infants and adults.

**Pathogenic Organisms.**

There are several spore bearing bacilli found in the intestines of these. B. Aerogenes Capsulatus, B. Rubifaciens are perhaps the most important.

B. Aerogenes Capsulatus (Klebs.)

This a gas producing bacillus described by Klebs and Huttel ("Bull. of the John Hopkins Hosp.," Vol. IV. 1892. July 1st and August 1st) who gave it that name.

It is identical with the B. perfringens of Hesse and Frankel's gas-phlegmon bacillus.

It may be found in small numbers in the intestines of the majority of healthy adults, and in larger numbers in children.

In pathogenic conditions it is often very numerous.

Klebs and Hesse in ("Jour. of Experimental Med." Jan. 1896, p. 6) found it in cases of gas tro-
Anorectal ulcer, epidermolysis ulcerations of intestine, strangulated hernia. 


Lassim ("Ain de l'Inst. Pasteur," XIX, 1905, p. 273) describes instances of superficial ulceras causing an intestinal affection of children, which he ascribed to the presence of almost pure cultures of *B. Pyocyaneus*.

An organism was isolated by Klein ("Reports Med. Off. Lab. Gou. B.,” XXV, p. 171; XXVII, p. 210) from evacuations in an outbreak of diarrhoea following the ingestion of milk containing the bacteria, to which be gave the name *B. Subtilissimus* *Sporogenes* which was subsequently found by Klein in certain cases of infantile and summer diarrhoea; in certain instances in milk, as a constant inhabitant of sewage. There appears to be some doubt as to whether this organism is not identical with *B. aerogenes*. Klein's organism however was viable and sporulated much more readily.

It thus seems that *B. aerogenes* is found in many diseases of the intestine with this intestine. It is certain that there are various strains of the bacillus as regards pathogenicity, & that the different...
Results obtained by different investigators with respect to that feature are due to this fact.

There are cases of intestinal putrefaction in which the predominating organism is B. aerogenes Capsulate, and it is often found in great numbers in cases of muscular atrophy, pernicious anaemia and other chronic disorders.

**Bacillus Putrefaciens (Carravan Bacillus)**

So-called by Blenkinsop. It is the B. aerogenes Capsulate, a spore bearing strict anaerobe. Blenkinsop ("Ann. of Med. Pasteur," XX p. 407, 1906) says there are two organisms B. putrefaciens & B. parasputrefaciens, the former accompanying proteins & the latter sugars.

How far it acts in intestinal putrefaction is difficult to state, as it does not always act associated with other microorganisms especially B. aerogenes & some of the cocci.

Rodella ("Arch. f. Hyg." lxxiii, 1905, p. 324) says it is a cause of caries of the teeth.

**Streptococcal & Staphylococcal Infections of the Throat.**

The human intestinal tract in health is probably normally free from cocci, as they are destroyed in the stomach & duodenum.

Children are more susceptible to these infections.
At Boston & Berlin, think that some of the severe forms of acute colitis in infants are due to streptococci. In many of these cases there is little doubt that they are secondary to enteric infections of the colon epithelial group.

Cunliffe ("International Med. Magazine," Feb. 1897) made a careful study of thirteen cases of summer diarrhoea. He thought that B. coli was the pathogenic agent, but noted that it was often associated with streptococci. "S. dysgenes." Conger.

In adults, it is rarely that the intestine is affected by streptococci unless they are virulent. It is interesting to note that a chronic streptococcal diarrhoea often precedes or occurs during the course of cases of severe or pernicious anaemia.

Hale-Perkins describes a case of mucous colitis ("The Lancet," Vol. II., 1910.) in which he found streptococci, "S. dysgenes." Conger, and a bacillus having characteristics between 13. Cadii aerogenes and the bacillus of Friedländer. A vaccine prepared from these two organisms afforded a cure.

It is well known that occasionally phlegmonous gastritis is due to streptococcal infections.

In appendicitis streptococci are often found in large numbers, though their relationship to the
A issue is not quite settled. Judging by Sargents- 
(“The Lancet.” Vol. I. March 4th. 1908) Sargents may 
Cases of appendicitis found the following organisms 
present in varying numbers in various cases.
B. coli in different strains; Staphylococcus pyogenes; 
the pathogenic Staphylococci; B. aerogenes; Capsalata 
B. Welch; B. pyocyaneus; & the usual intestinal 
flora.

They found that the most virulent organism was 
Staphylococcus pyogenes, & that cases with which 
it was associated were almost invariably fatal.

A case of pneumococcal colitis has been 
described by Hall White Fother in “The Lancet” 

Very little is known as present as regards 
Staphylococcal infections. The organisms have been 
found in abundance in cases of ileus with peritonitis 
but their significance is unknown.

There are still one or two important organisms 
which may be briefly alluded to. Amongst them is 
Spilbillum Cholerae Asiatica.

This, as its name implies is the cause of Asiatic Cholera 
& was discovered in 1884 by Koch. (“Deutsche Med. 
It is also known as the comma bacillus. It is not a true bacillus, but really a spirochete. In acute cases they do not invade the intestinal wall, but in more protracted cases they are found in the depths of the glands. Koch was unable to find the organism in the internal organs. He concluded that the constitutional symptoms of the disease result from toxins absorbed from the intestine.

Of more interest to us in this country is the Bacillus Tuberculosis.

Tubercular disease of the intestine may be primary, or more commonly, secondary to disease of the lung. The primary form is more frequent in children, and may set in with colicky pain, abdominal fever. The secondary form is very common in the later stages of phthisis.

A chronic hyperplastic tuberculosis may exist in the cecum, giving rise to a firm, tubular mass in the right iliac fossa. Hall Simpson ("The Lancet," Vol. II, 1905, p. 1320) describe a case affecting the ascending colon. They believe it to be a case of primary infection of B. tuberculosis in the mucous membrane of the cecum.

Can pulmonary tuberculosis be caused by invasion of B. tuberculosis from the intestine?
This is a question that has not yet been decided.

Von Behring states that in adults pulmonary tuberculosis is due to absorption of Leptome bacilli from the intestines in childhood; but this view is refuted by Calmette & Guérin ("Ann. de l'Inst. Pasteur," 1905, vol. 25, p. 561). From the results of experiments on animals, they state that the adult is more susceptible to pulmonary infection by intestinal route than the infant.

On the other hand, in the same loc. cit., the journal quoted above, Prof. de Valler describes experiments on calves in which he gave T.B. by the mouth. He found that they quickly invaded the mesenteric glands of the lungs, without causing any intestinal lesion. He concludes that pulmonary lesions following on absorption of T.B. from intestines are much more common than supposed, as the intestinal bacilli leave no trace in the intestines.

It may be interest while describing pathogenic bacteria to glance at some of the organisms which have been discovered in the search for a specific organism for infantile diarrhea.

As we have seen, B. Asperger has often been associated with it. In three cases it is usually
Among recent observations are those of Morgan, Stedingham ("Proceed. Roy. Soc. Med." 1907, ii. Epidemiological Section, p. 133) have found in 63% of cases examined, in stools and intestines an organism non-vegetative, which has been called "Morgan's Bacillus." This is probably another factor in the disease. They found in 50% of such cases that a positive agglutinative reaction was obtained.

Stenhouse, Williams, and others in Liverpool have discovered an organism which they term "Bacillus H." which differs from Morgan Bacillus and all others. They say it is closely related to the paratyphoid group.

It is thus apparent that so far there is no specific organism for diarrhoea, gas, and intestinal fever. ("The Practitioner," Vol. 1, 1906, p. 705.) These probably is not one. Many workers would appear to forget the influence of accompanying food in the etiology of this disease.
III. Bacterio-Therapy.

Curing to the genius research work of Professor Des Metchnikoff, Bacterio-therapy is now a well-recognized method of influencing the nutrition of the body, assisting physiological processes, retarding degenerative changes, preventing or arresting existing diseases. Yet when all is said and done, this new branch of therapeutics is still in its infancy.

There are three methods by which bacteria or their products can be utilized as remedial agents.

1. Injections of Serums.
2. Injections of vaccines.
3. Bacteria given by the mouth.

1. Serum Therapy.

Following on the success obtained with antitoxin, diphteria serum, workers began to try the effects in other diseases.

With the diseases we are concerned with, most of the work done applies to Apsenlentia & Leptodio.

Antitoxinic serum has been used for some years & there is an increasing amount of evidence to show that its effects are beneficial. The Apsenlentia bacillus secretes a soluble toxin so that a true antitoxic serum can be produced.
Shejia says that sub-cultures from the first generation of bacteria are more effective in the preparation of serum than that obtained from bacilli obtained after passage through animals (Shejia, Geller's "System of Medicine," Vol. II, p. 798).

As in most cases of serum therapy, the earlier in the disease the treatment is given, the better the result. Of 50 c.c. of polyvalent serum is given when the diagnosis of dysentery is made, followed by 50 c.c. of the specific serum, there is improvement in from four to twelve hours.

In Amoebic Dysentery it is useless to try serum treatment. Antileishmanoid serum. Compared with the serum treatment of Dysentery, that of Leishman has so far not given very encouraging results. The Leishman germ invades the blood but does not seem to produce a soluble toxin, and Vaughan, who has done a great deal of work in this respect, thinks that it is extremely unlikely that any antitoxin comparable to that of dysentery will ever be obtained.

Stern, ("Zeitschrift für Hygiene." 1894, Bd. XV, p. 458) found in the blood of persons convalescent from Leishman a substance which had a protective action upon infected guinea pigs. This observation has been abundantly confirmed by other workers.
As notably Vaughan ("Am. Journ. Med. Science," Sept. 1908) who terms it a protein poison. This sediment, or residue, has been used as a therapeutic measure, then given better results than serum treatment. Richardson ("Boston Med. & Surg. Journ." 1907. CIVI, p. 449) gives his experience of serum therapy in 130 cases of typhoid. He says that an early diagnosis being often impossible, specific therapy is consequently seriously handicapped. (2) Specific therapy seems to increase the tendency to relapse. (3) Anti-typhoid serum is no more effective than residues. (4) Much more expensive. (4) The non-toxic residues of Vaughan seem to complete the course of typhoid, but render it milder. These apparently very effective in preventing relapses.

2. VACCINE THERAPY

Antisyphoid Vaccine consists of a sterilised bouillon culture of B. typhosus of high virulence which is injected subcutaneously. Wright was able to show that in the S. African war his method diminished the death rate among those inoculated ("The Lancet," Sept. 6th, 1902.)

This vaccine is used both as a preventative and as a curative agent.

(a) Prophylactic inoculation is largely carried out in the British & American armies. Capt. Scain, R.A.M.C. (Journ. R.A.M.C. Aug. 1910) found that under his charge twenty-three cases of typhoid occurred among the un inoculated with three deaths. Four among the inoculated with no deaths. Moreover, in the four inoculated cases there were no complications.

Russell ("Jin. Hosp. Med. Bull." Year, 1910) in the American Army used it on 1400 men totalling 3640 doses. Concludes that vaccination undoubtedly protects to a very great extent against the disease, is indispensable in the case of troops & others exposed to infection. The procedure is easily carried out & no untoward results occurred in the whole series of his cases.
Therapeutic circulation. There is an increasing amount of evidence to show that this method of treatment of typhoid is distinctly beneficial. Watson ("Boston Med. & Surg. Jour.," May 24, 1910) gives the result of vaccine treatment in 210 cases of typhoid, as against 70 cases untreated in the same way. Vaccination appeared to shorten the duration of the fever by nearly ten days while the number of relapses among the untreated was three times as great as that of the vaccinated.

Richardson (Journ. Amer. Med. Assn., Jan. 22, 1910) was not so fortunate in his experiments, but vaccination in his cases seemed to have a distinct reducing action on the number of relapses. Capt. Smeallie in R.A.M.C. ("The Practitioner," Sept. 1910) did 36 cases of whom two died, but he noted an unusual freedom from relapse and complication in the remainder. Capt. H. J. Wilson (Journ. R.A.M.C., Aug. 1910) records six cases treated with vaccine. The cases were all brought under treatment early and left severe, and the treatment was distinctly beneficial.

The results therefore of antityphoid vaccine as a therapeutic agent are most encouraging.

There are cases of other intestines disorders
Where vaccine therapy has been attempted with good results. A Case of Tuberous Colitis cured by vaccine are described in p. 42. 47.

L. P. Stephens ("Ind. Med. Gazete. Jan 1909") records a Case of Chronic Appendicitis subjected to various treatments in the course of five years, which was completely cured by vaccine therapy.

At present, the dosage of vaccine is the stumbling block to progress in this form of therapy. When more accurate dosage is obtained, the results will be more brilliant than they are at the present time.

3. By the mouth.

The method of administering bacilli by the mouth as a therapeutic agent has been introduced in recent years, chiefly by the advocacy of Metchnikoff. He believes that old age is due to the absorption of poisons, the products of putrefactive organisms living in the large intestine. These organisms require an alkaline medium to be suppurative rendering it acid, so that the putrefactive organisms would not be able to thrive. As a convenient method of attaining this result he gives Taela Acid Bacilli, which are non-pathogenic, readily reclinable in the intestine. When this is accomplished, the bacilli
Hervich, 

Produce Cætic acid.

Vissir. (C. Ann de l'Inst. Pasteur,” No. 5. In XIX.)

found that in some cases of infantile diarrhoea of fermentative origin, the B. bifidus disappears; other organisms, including B. perfringens take its place. In recovery he stated that these abnormal forms disappeared & that B. bifidus reappeared. He found that by giving per os. B. bifidus & the Cætic acid bacillus, the development of B. perfringens ceased. A cure was effected.

Horno. (“Münch. med. Wochenbgr.” 1908. No. 9, B. 1.)

tried Vissir's plan. He found it necessary to give large quantities of B. acidolytica, & thought the results were better when given per rectum.

Horno's plan however was not been followed by other observers.

Dunn (“Arch. Pediat.” N. Y. April, 1907) tried it also in 35 cases of fermentative diarrhoea of children with very good results.

The same author in his (“Journ. Ambr. Med. Assn. Aug. 21st. 1909) gives details of 120 cases treated in this manner. He used buttermilk which was first-pasteurised & then inoculated with pure cultures & ripened. Twelve of these cases were of the irritative type & aid not benefited by treatment.
8 were of the infectious type — 4 benefited & 4 did not. The remaining 100 were fermentative: in 74 the treatment was entirely successful, in 12 it was partially so & in 14 it failed.

Since this method of treatment was introduced it has been taken up & used indiscriminately both by the profession & the public as a cure-all for all sorts of diseases, & this accounts partly for the misleading feeling with which it is regarded to-day.

There are however certain cases in which it does good. Grimshaw ("Brit. Med. Journ." Nov. 19, 1910) finds it useful in three classes of cases: (1) Those in which the irritating micro-organisms cannot flourish in an acid medium, e.g. in many forms of chronic Colitis; (2) Where pathogenic toxins are produced too readily, or are secreted too slowly, as in certain cases of intestinal toxæmia; & in Antered renal secretion; (3) Some cases of "maladie uaqueaire."

It is also useful in cases of Ulcerous & Other forms of enteritis, Gastric Anacidity, Chronic Intestinal Catarrh, pernicious Anaemia, Sub-acute & Chronic Infarcts, Rheumatism & Gout.
Conclusions.

1. That Bacteriology has made, is still making, great strides in advancement—since Swartz of Edinburgh discovered the germ of typhoid fever in 1865.

2. That improved methods of technique must some explain morphological differences in bacteria which biochemical methods prove to be identical.

3. That the function of the normal intestinal flora is not concerned with the process of digestion but is that of antagonising bacterial foes which gain an entrance to the intestinal tract.

4. That abnormal proliferations in the intestine are mainly effected through the agency of anaerobic bacteria.

5. That the Bacteriology of the Intestine is now explaining the cause of many of the so-called "cryptogenic" diseases.

6. That the several forms of intestinal diseases are dependent on bacteria which in their biochemical characteristics are furthest removed from the Colon bacillus.

7. That there is no one specific organism which is the cause of "Cholera Infantum".

8. That Bacterio-therapy, though as yet only
in its infancy, is one of the greatest advances that has been made in recent years. It must in time replace 'eclectic' methods in the treatment of disease; and that vaccine therapy in particular has an immense future before it.