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ENTERIC FEVER

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Thesis

BY

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ENTERIC FEVER

NOMENCLATURE.

Typhoid fever — so called from its supposed likeness to typhus fever, the term "typhoid" being also used as an adjective — has received a multitude of names, of which the following are those most frequently encountered in ancient and modern literature;

"Abdominal Typhus" — from its supposed resemblance to typhus fever, but in a different locality.
"Pythogenic Fever" — the name given to it by Murchison (Treatise on Fevers), who believed it to be "born of putridity."
"Enteric" — abbreviation of the second synonym.
"Slow Nervous Fever" — the designation of Huschmann (Essay on Fevers) 1775, p. 74.
"Twenty-one-day Fever" — Gregory (Practice of Medicine, 5th Ed. 1839).
"Infantine Remittent Fever", "Worm Fever", "Bilious Fever", Synonyms for typhoid Fever in children in whom some of the characteristic symptoms may be obscured.

"Infective Gastritis" — Liebert.
"Simple Continued Fever" — older writers.
"Autumnal or Fall Fever" — American synonym.

"Dothiénenterite" — Pierre Bretonneau, of Tours, 1813.
"Fièvre typhoïde" — French rendering of English term.
"Enterosmesenteric Fever" — Petit and Serres (Osler's Principles and Practice of Medicine, 1903, p. 1.
"Abdominal Typhus", or Nervenfieber — German. The former is explained above.

DEFFNITION.

"A febrile disease, produced by a specific poison, and characterised by inflammation, and
sloughing, or ulceration of the glands of the small and sometimes of the large intestines, and especially of the agminate and solitary glands of the ileum, together with infiltration of the mesenteric glands, with enlargement of the spleen, and the presence of an inconstant roseolous rash.

ETIOLOGY.

HISTORICAL.

The recognition of typhoid fever as a clearly defined disease dates back to the early part of the nineteenth century; although the term "typhus" can be traced into remote antiquity, being applied to a febrile condition attended with stupor and obscuration of consciousness. The descriptions of the condition given by the fathers in medicine (Galen, Hippocrates, Spigilius, Willis, Morgani, &c.) could barely apply to any disease other than typhoid fever. In this connection Wunderlich's remarks (Geschichte der med.) are especially interesting.

The writings of the early authors clearly show that typhoid fever in its clinical manifestations was frequently confounded with plague, malaria, typhus, and relapsing fever; and continued to be so until recent times, when evolution of clinical, diagnostic, and bacteriologic methods allowed the disease to be eliminated from the other affections with which it was so frequently confused.

Relapsing fever was perhaps mistaken for typhoid more than any other malady; but even now, seldom troubles us in that respect in this country where it is of great rarity.

About the beginning of the nineteenth century, or the end of the eighteenth, typhus fever was, especially in England and France, mistaken for typhoid, the two maladies being often prevalent at the same time in certain localities. It was in the latter country that the lesions of enterica began to be more clearly recognised, but even then, were often confused with
certain disorders supposed at the time to be contagious, as "war-typhus", "camp-typhus", and "starvation-typhus."

It was in France, however, in the year 1804, that Prost (Medicine éclairée par l'observation et l'ouverture des corps, &c., Paris 1804) from observations, taken at random, from 200 autopsies, first demonstrated that the fevers hitherto known as typhoid had always associated with their definite intestinal lesions. His conclusions were next confirmed by Petit and Serres (Traité de la fièvre entéro-mésentérique, Paris, 1813), to whom belongs the credit of having first proved that the lower part of the small intestine (ileum) is first affected by the fever, the specific nature of the lesions, and their probable origin from the irritation of a special poison.

Bretonneau (De la dothiénterite, Arch, gén. de med. 1826) who further in 1828, proposed the name of "dothiénterite" to denote the specific nature of the intestinal lesions, was able subsequently to show that the intestinal lymphatics, and not the intestinal mucous membrane, were the seat of the morbid processes; Louis (Recherches sur la maladie connue sous les noms de gastroentérite, fièvre puride, adynamie, &c. Paris, 1829), in his classical work giving the name of "typhoid fever" to the disease, clearly proving the essential relationship between the clinical manifestations, and the lesions so demonstrated. But, it remained, however, for Chome-l to definitely establish, from anatomical and clinical evidence, the absolute difference between typhoid fever and other maladies; as well as (with the French authors cited) the contagious character of the disease.

The conception of the difference between typhus and typhoid was, largely due, however, to the studies of Hildenbrand, of Vienna, who, in 1810, published a work pointing this out (Ueber den ansteckenden Typhus, Vienna, 1810)

In spite of all this, however, a good deal of disputation continued as to the mooted points mentioned; until, in 1837, when the difference between the two diseases - especially as regards the rash - was firmly established by the Americans, Pennock and Gerhard, of Philadelphia. (On the Typhus Fever which occurred at Phila., in 1836, showing the distinctions between it and Dothisienerstemer. Jour. Wed. Sci. vols. XIX & XX, 1837) Their researches were still further substantiated and supplemented in the same country, by the Jacksons (Sen. & Jun.) Enock Hateleand Shattuck; as well as by Stille and Flint, Perry (1836)
Barlow (1840) Stewart (1840), and several others, elsewhere. Amongst the latter particular mention should be made of Sir. Wm. Jenner (papers extending over four years, 1849, 1853), Louis (Treatise, 1841), Murchison, and Griesinger.

In spite of the essential differences between the two diseases having been thus established, there were still some to be found who persisted in believing the maladies to be in some mysterious way associated, until in Germany, the quietus was given to their contentions by Griesinger, Liebermeister, and Curschmann (Ziemssen's Handbuch 3rd. Edn.)

With the great advance in our knowledge of sanitary science, the applications of its principles by public authorities, the establishment of medical officers of health throughout the county, the ravages of the disease began to be seriously checked; and still more so when its propagation by water, food, &c. came to be recognised.

THEORIES REGARDING THE PROPAGATION OF TYPHOID-

(1) The Decomposition Theory-

Amongst the earlier writers, all sorts of factors (cold, over-exertion, emotion, &c.) were considered in some mysterious way or other to be etiologic - hence the confusion noted.

Following these came the school holding the disease to be due to a putrefactive process in air, food, or drink - thus the term "Putrida nervosa", "ataxic fever", &c. These views were firmly held even down to the last century, and to the time of Murchison (Treatise on the Continued Fevers of Great Britain, London, 1892) who first called the disease "pythogenic fever", and considered it to be due to the chemical decomposition of organic (more especially human) matter, even outside the patient's body. To establish his theory he produced considerable clinical and epidemic evidence, and showed how the disease so often followed upon partaking of contaminated water, or food, or after sleeping in ill-ventilated apartments, the air of which had been contaminated with putrescent material.

The next step in the advancement of our knowledge of the disease consisted in the attempts of Stich and Panum to prove the autogenous nature of typhoid fever; which they considered to be due to the introduction within the bodies of animals of putrescent substances alone, and that the malady was actually occasioned by the decomposition of faeces within the intestines independent of outside infection. The fallacious nature of this reasoning will become apparent as we proceed.

The Direct Contagion Theory.

This opinion, at direct variance with Murchison's
attributing the disease to putrefaction, was held (even before his investigations were published) in France, and strenuously advocated there by Gendron (Dothérient, observées aux environs de Chateau du bois, Arch. Gén. de Méd., Ser. 1., xxx), L'euret (Men. sur la dothérient. à Nancy, Ibid., Ser. i., xvii.), Trouseau, and Brettonneau; to the effect that the disease could be propagated in hardly any other way than that of direct aerial transmission from the sick person to the "Contact."

The opinions of the medical public upon these theories for a long time remained divided, until Budd (On intestinal fever; its mode of propagation, Lancet, 1856; ibid. 1859; ibid. 1860) completely established what is now believed as certain regarding the essential character of the disease, viz.: (1) that typhoid fever is contagious, and cannot therefore rise spontaneously; (2) that the poison is specific in origin and activity, being manufactured in the patient's body, and not outside of it as formerly supposed; (3) that the smallest quantity of it is sufficient to carry the disease to others; (4) that destruction of the noxious agent contained in the stools would render further spread of the disease impossible.

(3) The Localisation Theory.

The specific nature of the poison having been thus established, other factors (as its mode of individual endemic and epidemic dissemination, its behaviour in relation to season, climate, locality, its occurrence in the absence of contact or the consumption of infected articles) were far from being understood; and it cannot be said that special attention was directed towards their elucidation.

On the contrary rather, it was supposed that an intermediate host—such as the earth—was necessary to its propagation, maturation, and multiplication. This view is even yet upheld by a few on the strength of the disease being sometimes strictly localised, or occurring with the commencement of excavation.

(4) The Ground-water Theory.

This famous theory received the greatest amount of support from Buhl (Ein Beitl. zur Aetiol. des typhus in München. Zeitseh. f. Biolog., Bd. i., 1865) who made the interesting discovery at Munich of the mortality rate of typhoid being highest simultaneously with the lowest level of the ground-water, and during the period of consequent dryness. His researches were elaborated and modified by Pettenkoffer (to the detriment it may be noted of the recognition of the real nature of the typhoid virus), leading to the general acceptance of the ground-water theory (Ueber
The advocates of the ground-water theory, how¬ever, did not entirely lose sight of the specific and contagious nature of the poison; but were chiefly concerned about the peculiar "process of saturation" which it underwent in the earth prior to its passage from it into the human body, by means of an exhalation via the air. This process they considered to be retarded by dampness of the atmosphere, as well as by the high level of the ground-water covering its maturation place, cutting off its connection with the surface of the earth; communication with the air occurring with the fall of water level.

(5) The Water-infection Theory.

The ground-water theorists were not long left in enjoyment of their vantage ground, for theirs had, in 1873, to give place to the water-infection theory, the enunciators of which were Liebermeister (Ges. Abhandlungen) and Biermer (Volkmann's Sam. klin. Vortr., 1873, no.53). to merely name it is sufficiently descriptive.

Discovery of the Specific Organism.

Buhl and Pettenkofter were the means of arousing interest in the virulence of the typhoid poison, and so paving the way for the later recognition of its specific nature. As early as 1871, we find von Hecklinghausen (Würzb. Zeit, 1871) Eberth (Zurkenmitniss der bakteriolog. wykosen. Leipsic, 1872), Klein (Reports of the Medical officer of the Privy Council and L.O.B. , No.6, 1875), So-koloff (Virchow's Archiv. Bd. 66. 18769, and Fischel (Prager med. Woch., 1878) endeavouring to demonstrate (by frequent observation of the cocci in the intestines of typhoid patients) the existence of a pathogenic typhoid virus.

To Eberth (Virchow's Archiv. B d. 81, u. 83) belongs the great honour of the discovery of the typhoid bacillus (now called after him) in the year 1880. He was, however, unable by cultivation and inoculation, to give it the hall-mark of specificity.

The accuracy of his discovery was, in this country, demonstrated by Coates, Cro-oke; and elsewhere by Coze, relz, Maragliano, Koc-h (wittheilunge aus dem Knis. Gesundheitsamte, bd. i.) Meyer (Inaug. Dissertat., Berlin, 1881) Klens (Ar-ch.f. exper. Pathu. Pharmak., Bd. xii. u 13) and Friedländer, all of whom, however, failed to cultivate and inoculate the organism.

We really owe our present knowledge of the bacillus of Eberth to Gaffky (wittheilungen aus dem Kais. Gesundheitsamte aus dem Kais. Gesundheitsamte, Bd. 21.), who in spite of his failure to produce
experimental typhoid fever by inoculating animals from a pure culture, was able to reason himself, and others, into believing that the baccillus was pathognomonic of the disease. Great credit is also due to Lösener for a mass of substantiative evidence. These pioneers gradually evolved what we now know as to the development and morphology of the baccillus, and its behaviour inside and outside the body of the affected person. The finding of the organism in the skin, spleen, urine, and stools, is due to other observers; before the researches of whom all experimentalists had utterly failed to produce the fever in animals by feeding them on typhoid dejecta.
BACTEROLOGY

Definition-
"The micro-organism known as the "bacillus typhosus" the "bacillus of Eberth", or the bacillus of Eberth-Kaffky", and to be pathognomonic of typhoid fever, is a motile, flagellated, non-liquefying, non-chromogenic, aerotolerant, and optionally aerophilic pathogenic bacillus, staining by ordinary methods, but not by that of Gram."

We have already noted its discovery by Eberth, and its experimental study by Koch (Witth. aus dem Kaiser. Gesundr., i., 45) &c., and its first pure culture from the lymphatic glands, Kaffky, in 1884.

MORPHOLOGY.

Size- The bacilli consist of short thick rods, about twice as long as wide (1 to 3 μm by 0.5 to 0.8 μm), their length being, roughly, one-third the diameter of a red blood corpuscle. Their poles are rounded, but they are seldom known to form chains.

Morphological Variation-
Thionin and Masselin (Brit. Med. Journ., Jan., 1895) were the first to point out the fact of their size and shape varying with the quality and age of the culture medium; in that when grown in bouillon the bacilli are remarkably slender; in milk much stouter; on agar-agar and potato thick and short; and in all gelatine cultures capable of considerable filamentous formation, as well as on potato of acid reaction.

Question as to Spore-formation-
The peculiar bright spots at the extremities and centre of the bacilli, which failed to take the stain, were held to be of the nature of spores (Buchner. Centralblatt f. Bakteriologie u. Parasiten., Bd. 4); but the same are now, however, regarded as merely either involution defects, or an unnatural change due to manipulation in heating and staining.

Flagella-
The bacilli are well known to be capable of active movement by virtue of their circumferential flagella, which number some 10 to 20 to each organism. Their actual movement varies; that of the larger forms being undulating and serpentine; of the shorter kind oscillating. The motile properties of both rods and filaments are best observable in a hanging drop of bouillon. This property of spontaneous movement is of diagnostic importance, as it is possessed only by one
other bacillus likely to be mistaken for Eberth's organism, viz; the bacillus coli; which is, however, distinguished by its flagella never numbering more than ten at the outside.

Staining Properties.

The bacilli take the ordinary aniline dyes, but with greater difficulty than other micro-organisms, and it is especially noteworthy that staining by Gram's method is never successful. It is particularly difficult to stain in the tissues, the bacilli relinquishing their colour in almost any solvent. Buchner (loc. cit.) draws attention to the markedly refractive polar dot-like bodies—carrying a distinctive stain—which the bacilli possess (called the "Babes Ernst Polar or Metachromatic Granules.") What are they? Probably some involuntary phenomenon, not spores (which the typhoid bacilli never produce) because their presence never leads to an increased organismal resistance, being held to be of no importance they need not be further discussed.

Procedure.

An excellent method of staining is that of Ziehl, which consists in the immersion, for a quarter of an hour, of the sections in the following solution:

Fuchsin............. 1 part
Phenol ............. 5 parts
Distilled Water ...... 100 "

They are next thoroughly washed in a 1% solution of acetic acid, in distilled water; the latter abstracted by treating with alcohol; followed by clarification and mounting in the ordinary way. It requires the aid of a 1/12 inch oil immersion lens to detect the bacilli, observable in the form of red-brown specs.

The most satisfactory method of staining, however, and one that gives uniformly successful results is the immersion of the sections in Leffler's alkaline methylene-blue, for fifteen minutes or more, wash, denydrate, clarify in Xyloc, and mount in Canada balsam.

Isolation.

As a rule, the typhoid bacilli present little difficulty in this respect and usually their number is in inverse proportion to the severity of the illness. They can be isolated from the spleen, in pure culture, lymphatics, mesenteric glands, and Peyer's patches. It is always advisable not to delay the autopsy, as on opening the intestine one may be disappointed to find an invasion of the tissues to be examined by the bacillus coli. In preparing cultures it is absolutely necessary to negative the presence of the latter organism, and this is done by the addition of glucose to the medium to prevent its decomposition.

Owing to their lack of concentration, the isolation of the bacillus typhosus from the spleen is
not to present some difficulty; so that it is as well in this connection to follow Fränkel's suggestion by at once wrapping the organ in clothes soaked in bichloride solution, and keeping the package in a warm room for three days, to allow of a gradual numerical increase, by development, of the bacilli.

Isolation of the bacilli from the stools of typhoid patients has been frequently attempted, but with scarcely satisfactory results; as even when the growth of the ordinary saprophytic organisms is prevented by the addition of carbolic acid, the colon bacillus is to be found in great abundance, as its resistance to the antiseptic is quite equal to that of the bacillus typhosus. Briefly, the method adopted by most bacteriologists, is to add 6 l.c.c. of a 5% solution of carbolic acid to the tubes, each containing 100 c.c. of melted gelatine, making thereby a 0.05% solution of the acid. A platinum needle, with adhering to it a few particles of the infected faeces, is stirred amongst the first tube of melted carbolised gelatine; a drop of which is then transferred to the second tube; and so on; after which the contents of each tube are emptied upon a sterile plate, and thereafter rolled inside a Petri dish.

CULTIVATION-

The bacillus typhosus thrives quite well at ordinary room temperature; but by far the best results are obtained when one of 37°C. (blood heat) is secured. The presence or absence of oxygen is practically immaterial to its growth; thus proving it to be a facultative anaerobe; but it must not be forgotten that an atmosphere produces a more energetic and abundant propagation.

CULTURE-MEDIA.

Gelatine Plates-

Deep colonies are formed upon gelatine plates, under the microscope, of a circumscribed form, the more superficial ones being much larger, and in appearance like unto vine-leaves, i.e., a thin iridescent layer, with notched edges, and a brownish-yellow centre.

Gelatine Stab-

The stab itself appears thread-like, grayish, and granular; the surface growth rounded, notched, of dry lustre, flat, thin, iridescent, and transparent.

Gelatine Streak-

The growth is white, thin, and exhibits a tendency to spread.
DIFFERENTIAL MEDIA

These are used for the differential diagnosis between the colon and the typhoid bacillus, the colonies of which would otherwise present similar appearances. The following are, from a vast number, the most useful.

Elsher's Medium-

Elsher (Zeit. f. Hyg., xxii, neft. i. 1896) recommends the use of one kilogram of grated German potatoes, to be macerated for twelve hours or so in a litre of water, the juice being subsequently pressed out, and as much of the starch as possible extracted by filtration. The medium is next neutralized (to slight activity) by the addition of 2.5 c.c. -3 c.c. of a 1/10 normal salt solution to each 10 c.c. of the juice; lithmus being used as the most convenient indicator (or phenolthalein - Abbott) 10% of pure gelatine is next dissolved in this, boiled, and the whole neutralised as before; followed, after filtration, by the addition of 1% of iodine of potassium; after which it is ready for tube-sterilization in the ordinary way.

From this medium - used in connection with the dejecta and water-plate cultures can be obtained of no organism except the colon and the typhoid bacilli. This is a point of practical importance, as the coarse granular colonies of former can usually be distinguished in 24 hours, whereas the latter have not had time to develop. After 48 hours, however, the characteristic, small, round, dew-drop, finely-granular, and shiny colonies of the bacillus typhosus are clearly discernible. Using this medium, Briger (Deut. Med. Koch., 1896) Richardson (Boston Med. and Surg. Jour., vol. cxxxvii, 18) and others, were able to isolate the bacillus during the febrile state of typhoid, in nearly every instance.

Remy's Medium-

Remy suggests (Ann. de l'inst. Pasteur, Aug. 1900) that better results would be obtained by the use of his potato-like artificial medium, and with less risk, than in the former case, of having the typhoid bacillus obscured by the colon organism. He claims facility of differentiation in that the colonies of the typhoid micro-organism appear on the medium to be small, bluish-white (sometimes evolving gas), whereas the colon colonies are yellowish-brown. This medium has stood the test of long experience in Rémy's laboratory; and in none of his experiments (23 published) did he fail to isolate the bacillus of Eberth from the typhoid stools.

The procedure recommended - somewhat tedious - consists in the use of a dextrine and glucose-free preparation, having the following formula:
Distilled water .................. 1000.0 grams
Asparagin ...................... 6.0 "
Oxalic acid .................... 0.5 gram
Lactic acid .................... 0.15 "
Citric acid ..................... 0.15 "
Disodic phosphate ............ 5.0 grams
Magnesiumsulphate ............ 2.5 "
Potassium ...................... 1.25 "
Sodium chloride .............. 2.0 "

The salts, with the exception of the sodium one, are to be pulverised, and dissolved in a flask containing the distilled water; 30 grams of Grubler's peptone added; and the whole heated for 15 minutes (under pressure) in an autoclave. Following this, the contents of the flask are transferred to a similar receptacle, containing about 150 grams of gelatine; and the whole shaken until solution be effected: when a sufficiency of soda solution, to secure slight alkalinity, is added. The mixture is now subjected, for 15 minutes, to a temperature of 110°C. in the autoclave, and thereafter acidulated with a ½ normal sulphuric acid solution; so that 10 c.c. have an acidity neutralised by 1. 2. c.c. of ½ normal soda solution; such solution being equivalent to 0. 5 c.c. sulphuric acid per litre. The remaining part of the process consists of the sterilization of the mixture, for 10 minutes, by steam, filtering, correcting the acidity (if necessary), aiding the sulphate of magnesium, dissolving, pouring into test-tubes, followed by intermittent sterilization, and (at the time of use only) finally aiding to each tube 0. 1. c.c. of a 2.5% solution of carbolic acid, together with a 35% solution of lactose.

Kashida's Medium—

This medium sometimes goes by the name of "lithmus-lactose agar-agar," and was suggested by Kashida (Jours. of experim. Med., Nov., 1897, Vol. ii, No. 5) for diagnostic purposes, and consequent upon his observing how the colon bacillus—in a solution of bouillon, containing 1.5% of agar-agar, 2% of milk sugar, 1% of urea, and 30% of tincture of lithmus—produces an acid reaction; converting when liquefied, and placed in Petri's dishes, in an incubator, for 16 hours—the blue colour of the medium into a red one (the typhoid bacillus having no such colour-reaction); as well as the evolution of gas—vapour of ammonium chloride—on holding a yod, dipped in hydrochloric acid, over the dish.

Hiss's Method—

Hiss, by the use of two media, was able to isolate the typhoid bacillus from 17 of the 21 cases studied. Either of them can be used for examination of the typhoid stools.

For Tube-Cultures—

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agar-agar</td>
<td>5 grams</td>
</tr>
<tr>
<td>Gelatine</td>
<td>80 &quot;</td>
</tr>
<tr>
<td>Beef-extract (iebeg)</td>
<td>5 &quot;</td>
</tr>
</tbody>
</table>
Sodium chloride ..... 5 grams to the litre
Glucose ................ 10 " " 

The beef-extract and the sodium chloride are mixed with 1000 c.c. of water, and the agar added; the gelatine, and the whole dissolved by boiling, and brought, by means of trituration (with phenolphthalein as an indicator), and hydrochloric acid or caustic soda, to a solution equivalent to 1 ½ % of normal acid, and 25 c.c. of a watery solution of egg is now added, and finally the glucose - the medium having been boiled for 45 minutes, and filtered through absorbent cotton.

This medium is utilised by the ordinary puncture method, the important point being that no bacillus except the typhoid one can uniformly cloud it, without the accompaniment of either gas-bubbles or streaks.

II. for Plate-Cultures.

Agar-agar .......... 10 grams
Gelatine ............ 25 "
Beef-extract (Liebig 5 "
Sodium acetate ..... 5 "
Glucose ............. 10 "

This medium is prepared in the same way as "I", care being taken that acidity of at least 21 of normal acid be indicated, and that the gelatine-agar be melted before addition of the acid, and not injured by exposure to the atmosphere.

With this medium the typhoid bacillus possesses the distinctive property of producing thready colonies; which, when deep in the medium, and when seen by transmitted light, are of a greenish-yellow or vitreous colour; of small, spherical, irregular outline; but it is the formation of the distinct filamentous outgrowths (sometimes single, sometimes thready, sometimes fringy) at rightangles to the periphery, which is so peculiar as to be pathognomonic.

Produced in this way, it is important to note that the colonies of Eberth's bacillus are much smaller than those of the colon bacillus; which latter appear by reflected light to be of a pale yellow colour (by transmitted light darker, more opaque, and much less refractive than the typhoid bacillus colonies), the superficial ones brownish-yellow, irregular in outline, of large size, and rounded outlines, (Journ. of Exper. Med., Nov., 1897, vol. ii, No. 6; & Med. New s. vol. 78, 19.);

Piorowski's Medium-

Piorowski (Berl. klin. Koch., Feb. 13, 1899) uses a medium consisting of urine two days old, to which has been added 3.3 % of gelatine, and 0.5 % of peptone. The colonies of the typhoid bacillus appear on this- if kept at 22° C. - in a few hours, in a radiating or filamentous form - those of the
colon bacillus, however, being sharply defined, round, and yellowish.

**Appearance on agar-agar.**

A. Agar Plate—
To the naked eye, the superficial colonies appear to be slightly elevated, roundish, irregular, shiny, and grayish-white; the deep ones gray and punc-tiform; but, when magnified (50 times), the former are of more regular outline, bright yellow and transpar-ent at the periphery, and darker yellow towards the centre. From the latter situation many lines extend outwards. The deep colonies are brownish-yellow, of smooth outlines, opaque, roundish, or whetstone shape; but either quite free from internal markings, or presenting only a finely granular appearance.

B. Agar Stab—
The stab manifests itself in the form of a finely-granular thread; the surface growth being grayish-white, of oily lustre, and irregularly round-ish, finally becoming yellowish-gray.

C. Agar Streak—
The growth is whitish-gray, and porous; so as to present numerous points of transparency. The out-line is wavy, and the edge smooth.

**Appearance on Potato.**
Here we have an especially noteworthy, and almost characteristic, "invisible growth." It must be remembered, however, that the bacillus sometimes produces a yellowish, or brownish, colouration, and that the phenomenon only occurs when the potato is acid. It was first described by Gaffky (With. aus dem Kaiserl. Gesundt., l. 45), and consists in the fact that on potato being treated in the ordinary way, as soon as two days, an almost typical wide-spread moist growth is produced, which remains invisible except to the most practised observer; but when touched with a platinum needle, it is found that the entire surface of the medium is covered with a thick layer ("invisible") of sticky vegetation, which sometimes can be drawn into delicate slimy thread, and which under the microscope are seen to be composed of bac-illi.

Should the reaction, however, be alkaline, the cultures resemble those of the colon bacillus, and are atypical, lururiant, brownish-yellow, moist, or dry, and with a spreading tendency.

**In Bouillon—**
The appearances produced by the bacillus in bouilHon are not characteristic, being little more than a diffuse cloudiness.

**In Milk—**
In milk a very slow, and very slight, acidity is produced, even after weeks of standing the milk remains uncoagulated.
1. Temperature—

The bacillus grows best at ordinary body temperature, and has been known to exist at as low as 10°C. It is killed at 60°C. It bears cold with much indifference; and seems quite uninfluenced by frequent freezing and thawing. Sedgwick and Winslow (Jour. Boston Soc. of Med. Sci., vol. 17, p. 181, Mar. 20, 1890) demonstrated, by the experimental freezing of infected samples of water from different sources, what quantitative reduction could be effected by extreme cold. This they found to lead to the disappearance of the bacilli in direct proportion to the time that the freezing process continued, the reduction averaging 99% after 12 weeks of the procedure.

The bacilli, on the other hand, bear great heat very badly, being killed in 10 minutes or so on being exposed to a temperature of 167°F.

2. Light—

Light seems to be as equally destructive to the bacilli as heat; their existence terminating after an exposure of 3 or 4 hours to direct sunlight. (Janowsky - loc. cit.; Gaillard - de L'influence de la lumière sur les micro-organismes, Lyon, 1888; and Buchner - Centralbl. f. Bakter. u. Parasit., Bd. xi. 25) Ordinary daylight, however, seems to be much less effective.

3. In Soil.

The bacilli can probably thrive in the upper part of the soil, for a distance of 19 inches from the surface; and much better if the soil be of a rocky impervious nature; in which case they have been known to preserve their potency for as long as six months; or, if fed with bouillon, even to 12 months (Robertson - Brit. Med., Jan. 8, 1898) They have never yet been known to be capable of multiplication under these conditions.

4. In Water—

Even after three months of immersion in distilled water, the bacilli have been observed to retain their potency; but in ordinary water they are speedily destroyed by the overwhelming matters of destructive saprophytes (Klemperer and Levy - Clinical Bacteriology).

It should be noted, however, that the condition of rest, or of movement, has a good deal to do with this; as in the latter case, the bacilli are rapidly destroyed (Di Matthai - ed Stagnitta, Annali dell'istit. sanità eperimentale di Roma, 1889). In spite of this experimental evidence, they are well known to be capable of preserving their vitality for weeks together in the contaminated water of rivers and springs, as well as in liquid mud (Wolfhilgel and Riedel - Arbeiten sus dem Kais-Sesund. de Méd et Chir. 1887, 8; and Strauss and Dubary - Arch. de Méd. experimentale, Bd. i.). The researches of Chantemesse
and Widal (Gaz. nebd. de Méd. et Chir., 1887, 9) and others are of great interest in this connection; and go to prove that typhoid fever can be propagated by means of both ordinary and artificial waters, in which they found the bacilli alive for weeks. The same discovery was made in connection with food-stuffs, and especially milk; in which latter they can exist for months.

5. In Fabrics—

The bacilli can live upon linen for as long as 70 days; and on occasion for 85 days—the average life upon other garment-material being 2 months.

6. In the Absence of Air—

Hermetically sealed cultures (bouillon) have been kept alive, by Stenberg, for over twelve months.

7. In Chemical Disinfectants.

The addition of from 0.1% to 2% of carabolic acid to the culture medium has been shown to have no effect upon the growth; but this tolerance to the acid, thought at one time thought to be characteristic, is not so, as it is manifested by other bacteria—the colon bacillus in particular (Konler—Centralol. f. Bakter. u. Parasit., x(iv), 89).

8. Against drying.

After being mixed with inert substances, and exposed on utensils, they can be pre-served for months; and in earth-dust, and sand for several weeks. The bacilli, however, fail to resist such drying as is necessary to the production of dust (Ficker—Zeigler's H. xxix, i; Germano—ibid. xxiv, 403; Uffelmann-Centralol. f. Bakter, u. Parasit., Bd. xv; and Gaffky Arbeit, aus dem Reichs-Gesund., Bd. v.)

PRODUCTION OF TOXINES.

This is suggested by observation of the great disproportion between the local and constitutional disorders during a typhoid fever attack. Brieger and Frankel (Ueber Ptomaine, Berlin, 1885-1886) claim to have accounted for this by the discovery of a supposed specific toxalbumin; whilst Klemperer and Levy (loc. cit.) endeavoured to demonstrate the presence of a toxine by the mere fact of so many cases dying from the disease without the presence of any local lesion whatever.

The toxine was first discovered by Pfeiffer and Kolle (Deut. red. Woch., Nov. 12, 1896), however, but in the bodies of the bacilli only, and never in the culture medium.

CHEMICAL PHENOMENA—

The bacilli produce neither colour, Indol, gas-bubbles from a carbo-hydrate; but it reduces a solution of lithmus; and converts a nitrate into a nitrite—eventually destroying the latter; forms lactic acid from grape-sugar (less readily from milk-sugar); and is capable of the evolution of much sulphuretted hydrogen.
Typhoid fever is with the utmost difficulty communicated to such lower animals as rabbits, guinea-pigs, white rats, mice, calves, apes; and chickens, pigeons &c. In addition these fail to respond to injection of typhoid blood; but the swallowing of typhoid faeces, or of pure cultures of the bacillus in their food (Gaffky — With. aus dem Kaiser. Gesun., i, 45); but Germano and Maurea (Zeigler's heitr., bd. xii. neft. 3. p. 494) were able to produce fatal peritonitis in mice, and abscesses in dogs, after the injection of 1 to 3 c.c. of a bouillon culture.

Lösener (loc. cit.) on the other hand, produced fatal typhoid symptoms by the injection of 3 mgrms. of an agar-agar culture into the abdominal cavity of guinea-pigs; and with much greater facility when the virulence of the bacillus had been increased by rapid passage from one guinea-pig to the other.

A similar result has been obtained by others following the introduction of the bacilli into the stomach (the contents being first alkalised) by means of an alcoholic culture.

Subcutaneous injections, however, produce, in the case of laboratory animals, septic symptoms of an almost invariably fatal character, by means of the intoxication produced by the organisms of sepsis (Pertuschky — Zeigler's H. xii, 261; and Sirotinin — ibid., i. 465).

Chenteresse and Sanarelli, and Widal (A. P. 1892, 755. & 721) were ultimately able by increasing the virulence of the bacillus (by various artificial methods) to a great degree, to produce symptoms of a typhoidal character in guinea-pigs, on injection of a suitable culture.

Chenteresse, acting independently, was able to produce sickness in both rabbits and monkeys, by the introduction of highly virulent cultures into the stomach; followed by fatal typhoidal symptoms on the poison being repeated a sufficient number of times — proving that the bacillus can ultimately overcome the resistance of the animal organism.

Pertuschky (Zeitsch. f. hyg., 1892, Bd. xxi. p. 261) was the first to notice considerable necrosis of the skin at the points of inoculation of the cultures, into mice, during the convalescence. Hemlinger (Ann de l'Inst. Pasteur. f. xi.) succeeded in producing a 10 to 12 day continuous fever — accompanied by diarrhoea and wasting — in rabbits and rats, by feeding on infected vegetables. The fact of the bacilli having been discovered in their usual habitats, makes his researches of considerable importance.
DISTRIBUTION OF THE BACCIll

Breath of the Patient-

Sicard (Sem. Méd., 1892, No. 4) holds that the bacilli are constantly present in the expired air; but this statement must, from lack of confirmation, be accepted with reserve; and in spite of the finding of them in both the expectoration and the diseased areas of the lungs in cases of typhoid pneumonia.

Perspiration-

Not a single person has been able to prove that the bacilli are eliminated in this way; their presence upon the skin being purely accidental.

Expectoration-

The fact of the bacilli having been found in this has already been referred to.

Blood-

Examination of the blood of a typhoid patient is invariably attended by negative results.

Faeces-

These are believed to be the most usual means of the bacilli leaving the patient's body, and carrying the disease to others. The stools are found to be teeming with them (Vilchour - Lancet. 1886, vol. ii. No. 3; Pfeiffer - Deut. Med. Woch., 1885, No. 29. Changeresse and Widal - Gaz. habd., 1887, 9; Karlinski - Centralol, f. Bakter. u. Parasit. kunde, bd. vili; and Kerkel and Goldschmidt - Centralol. f. klin. Med., 1887, 22).

Occasional failure, however, to find the bacilli in the stools has been recorded. Changeresse (Sic. de Biol., Feb. 22, 1886) failed to find them in the stools (3 out of 16 cases); and in the remainder, only during the third week of the fever.

For their existence in the stools, the bacilli require a feeble alkalinity, and a moderate temperature; given which, they can survive for months. Reversing the conditions, however, and especially on allowing of their alkalinity by a mixture with decomposing urine, they are speedily destroyed. It is of practical interest to note that in dried faeces they preserve their vitality to a marked degree. The exact procedure has been described, and need not be repeated.

Urine-

The importance of this secretion as a means of propagating the typhoid bacilli has only come to be recognised within recent years; and was drawn attention to by Neumann (Berlin. klin. Woch., 1890, 3, 121), he found the bacilli in the urine of 11 out of 48 cases studied. His results were confirmed by Petruschky (Centralol. f. Bakter., 1898, 14), who discovered them in 3 out of 50 cases; Richardson (Jour. Exper. Med., vol. iii & iv.), in 23 out of 104 cases, Horton
Smith (Lancet, 1900, vol. i.), in 11 out of 39 cases, and others. The number of bacilli in each cubic centimetre being 5000,000,000); and at the Johns Hopkins Hospital, in 10 out of 50 cases.

MODES OF ENTRANCE OF THE BACILLI TO THE SYSTEM-
The digestive tract is by far the commonest channel of entrance into the body; and for this direct "contact" is required, the disease being essentially contagious - not infectious, as are measles and scarlet fever, by inhalation. In the rare instances in which access has been obtained by the respiratory tract, the bacilli have been in reality with dust particles.

Once in the mouth, the bacilli soon work their way to the intestines and produce there their characteristic lesions in due course.

Typhoid bacilli and the Gastric Juice-
The behaviour of the one to the other is as interesting as important; the more so as we know the bacilli to be quite capable of existence upon a slightly acid medium. The gastric secretion (hydrochloric acid and pepsin) seems to have no detrimental effect upon them; so that their course onwards to the intestines is unchecked (Kitasto - Zeit. f. Hyg., B. A. vii; & Chanteresse and Widal - Arch. de Physiol. 1887).

It appears that in the large number of cases examined post-mortem, in which no intestinal typhoid lesions were discovered, the bacilli must have gained access by means of imperceptible openings - no evidence to the contrary having been so far adduced.

(Vide discussion by Opie - Bull, Johns Hopkins Hospital, vol. xii.).

PROPAGATION OF THE CONTAGION.

WATER.
Of all carriers of the poison, water is by far the most important. The probability of water being a vehicle has been suspected for ages (Vide; Liebermeister - Gesam. Abhand., S. 27-55; Gietl - Die Ursachendes Enterogenen Typhus im München, Leipsic, 1865; and Briemer - Volkmann's Sammlung klin. Vortr. 53), and is now more often investigated than any other with satisfactory results.

In the unsterilised condition, water may become the means of spreading the poison of typhoid fever; and there are few epidemics on record which have not been directly or indirectly traced to this means. To give an account of the mass of evidence adduced from time to time in support of the waterborne theory would occupy more space than is at our disposal; sufficient to note that under any circumstances,
provided the bacilli gain access to the digestive tract, typhoid will follow: the commonest method being by means of the drinking-water; and, next to that, solid or liquid articles or food partaken of in the unsterilised condition. What happens, usually, is that in some way or other the dejecta of the typhoid patient gains access to the drinking-water (commonly from privies, cesspools, &c. in the neighbourhood of the water supply), conveying the infection to a number of persons - and in direct proportion to the quantity of infected - liquid or solid-material consumed. Polluted wells, and small dairies naturally give rise to a minor epidemic, or endemic; whereas polluted reservoirs, of towns and cities, and articles universally consumed produce large epidemics, or "small pandemics."


From amongst the large number of epidemics consequent upon pollution of drinking-water, we select the following representative examples:

(1). In the year 1872, in a suburb of Berlin, lived some 1000 persons, in a state of over-crowding, and bad ventilation. Out of these 80 were attacked by typhoid fever; and enquiry revealed the fact that the water supply was derived from a single source, viz; a muddy polluted well - the offensive odour of which was proved to be due to its communication with a neighbouring cesspool. Curiously enough, typhoid fever had been absent from the district in former years when the well was as much polluted as now. That the outbreak was really due to this well, was demonstrated by the fact of the arrival of a typhoid patient in the district four weeks prior to the epidemic - the sick person supplying the specific bacillus, without which mere pollution of the water supply could not induce typhoidal symptoms.

(2). An instance, Illustrative of the facility of propagation of typhoid fever through the water supply is recorded by Liebermeister (loc.cit.) and is that of the epidemic of 1872, which occurred in the village of Lausen, where 17% were, during the autumn, attacked by the disease, and as many as 100 cases being reported during the first week. The remarkable feature, however, was that only persons who obtained their drinking water from the pump-wells
escaped; whereas the consumers of the water of the running springs were attacked, and that from contamination of the source by a cesspool overflow, and manure pit belonging to a house at some distance above the village, in which there had, during the summer, been four cases of typhoid fever.

(3). An example of the epidemic spread of the disease from a large stream is furnished by the famous Hambourg epidemic of 1885-1888 (Deut. Med. Woch., 1888; and Deut. Viertelj. f. Offenl. Gesund., Bd. xxvii., heft, 3) during the prevalence of which some 16,000 persons suffered, and 1,214 died. The water supply was at the time drawn entirely derived from the mine, and at a part of it polluted by sewage. Only those districts supplied therefrom exhibited an abnormally large number of cases, as shewn in the following table:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Cases</th>
<th>Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1884</td>
<td>1053</td>
<td>2.35 108</td>
</tr>
<tr>
<td>1885</td>
<td>2172</td>
<td>4.66 160</td>
</tr>
<tr>
<td>1886</td>
<td>3890</td>
<td>8.09 333</td>
</tr>
<tr>
<td>1887</td>
<td>6543</td>
<td>13.26 446</td>
</tr>
<tr>
<td>1888</td>
<td>3199</td>
<td>6.23 275</td>
</tr>
<tr>
<td>1889</td>
<td>3172</td>
<td>5.89 222</td>
</tr>
<tr>
<td>1890</td>
<td>1539</td>
<td>2.73 147</td>
</tr>
<tr>
<td>1891</td>
<td>1197</td>
<td>2.06 128</td>
</tr>
<tr>
<td>1892</td>
<td>1941</td>
<td>3.30 203</td>
</tr>
<tr>
<td>1893</td>
<td>1094</td>
<td>1.84 106</td>
</tr>
</tbody>
</table>

(Change of the source of water supply, and introduction of filtration.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Cases</th>
<th>Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1894</td>
<td>462</td>
<td>0.76 37</td>
</tr>
<tr>
<td>1895</td>
<td>597</td>
<td>0.96 58</td>
</tr>
</tbody>
</table>

**MILK**

This common carrier of infection has naturally been subject to repeated and searching investigation during epidemic times, with the result that it is found to act in the same way as the foregoing by admixture with the bacilli from human sources; not from the cow, in whom typhoid fever has never yet been proved to have been present.

Milk has been the means of propagating innumerable epidemics; as it is an admirable - boiled or unboiled - preservative, and nutrient, of Eberth's bacillus (Kaiser - Gesundhertsam., Bd. v.). for as long as a month or more. During this time the bacilli give no evidence of their presence - by acidulation, coagulation, or otherwise - so that the consumer partakes of the medium in total ignorance of its deadly nature. In most cases the source of the infection can be traced to either the dairy itself, or
to a well from which the adulterant has been taken. It is therefore the duty of the medical officer to see that the milk is never allowed to be polluted with water contaminated with typhoid faeces; even preserved and transported in vessel rinsed with same, or infected by the hands of those in contact with the patient; who also must not be allowed to perform the operation of milking.

(1). An interesting example of milk-infection is that afforded by the epidemic of typhoid which occurred in the parish of St. George's, Hanover Square, London, in the year 1873; the same being subsequently traced to an infected dairy; for only those persons who received milk from it were attacked. A striking proof of this consisted in the death of the inspector who recklessly drank some of the milk after his colleagues had failed to discover the source of pollution there; and the prompt subsidence of the epidemic consequent upon the closure of the establishment: at which it had been then customary for those in charge to rinse the vessels (and possibly, mix their contents) with water from a well in connection with a dung-heap which had received the dejecta from a typhoid patient at the dairy.

(2) Another similar epidemic is recorded by Cameron, of typhoid fever in Dublin, traceable to a dairy infected by three patients; the consumers of milk from other establishments escaping.

(3) The Strassbourg epidemic, studied by Schmidt (inaug. Dissertation, Halle, 1893) is of equal interest to the above; and occurred amongst the inmates of two prisons, who consumed unboiled milk from a polluted dairy— the epidemic subsiding amongst those from whom the source was later on cut off, and persisting amongst those not so dealt with.


BUTTER AND CHEESE
The possibility of both butter and cheese being the means of the spread of typhoid infection has been shewn by Heiz (loc. cit.), who found that Eberth's bacillus can exist in the former for a month, and in the latter for three days.

BEVERAGES.
Tea, coffee, and alcohol, have been proved by Pick (Arch. f. hyg., Bd. xix.) to have little or no injurious effect upon the typhoid bacillus; so that polluted water mixed with any of them may cause, contrary to what is generally supposed the spread of an epidemic.

VEGETABLES.
From the facility with which the bacillus can
exist upon vegetables, the same must be a prolific source of infection; and it is a matter of regret that the scrutiny to which milk, and water, are subjected is not extended to that also.

The same remarks, of course, apply with equal force to bread, and other articles of diet, none of which should be allowed to come in contact, directly or indirectly, with the patient.

**ATTENDANTS**

Nurses and attendants upon the patients, should previously subject themselves to thorough disinfection before mingling with healthy persons outside the patient's residence; failing which, the possibility of their being the means of spreading the infection is great.

**ATMOSPHERE**

The probability of dust particles being the means of disseminating the disease - spraying as it were, the infection upon the upper part of the digestive tract of unaffected persons - has already been noted. There seems, however, to be no risk of contracting the disease by merely inhaling the infection dust - the bacillus never gaining entrance to the system by the respiratory passages (Lassine - Thèse, Paris, 1890). Huchner and Budd (loc. cit.) however, seem to believe the contrary.

**EARTH**

The soil-theory, for long maintained a popularity, and led to such attention to drainage during epidemic times - the earth being supposed to be the nursery of the bacillus. Soon, however, and consequent upon the researches of Pettenkoffer and Bull, the ground-water to be regarded with suspicion, especially upon their adducing substantial evidence (unreliable and not generally applicable) of the number of persons affected in the city of Munich, and the mortality rate likewise, rose when the ground-water was at its lowest level, and vice-versa.

Pettenkoffer (Über die Luft und Grundluft, Braunschweiz, 1873) contended that the typhoid bacillus both develops and multiplies in the deeper layers of the soil (the seat of decomposition changes); this "dangerous layer", with a high level of the ground-water, having its connection with the surface of the earth cut off, but re-established with its fall; in the latter case allowing of the escape of the bacilli, in great numbers, by means of the ground-air.

Pettenkoffer's theory was not long promulgated, however, before its worthlessness (and inapplicability to cities other than Munich) was proved by Biermer (Volkmann's Sammlung klin. Vortr., 1893) and Liebermeister (Ges. Abhandlun, in Ziemssen's Handbuch, aufl., Bd. i.).
The theory of the distribution of the bacilli through the ground-air has been more contested, and less substantiated, than any other. Presuming, as it does access of the germs to the individual by means of the inhalation of the contaminated air - it is worthless; but it is as well not to overlook the possibility (though improbability) of the impinging of the same upon the faces, and thence gaining access to the digestive tract. Cases supposed to have originated in this way have most likely arisen through soiled hands, contaminated food, and the like.

HOUSEHOLD GOODS—

Apart from what has been said regarding the vitality of Eberth's bacillus under conditions of dessication, the importance of the subject demands some emphasis of the fact that it can quite readily with facility exist for a considerable period upon household articles, especially such (bedding &c.) as are being continually contaminated by the patient; from which it disseminates itself by means of those handling the same (nurses, laundresses, &c.), or indirectly through the agency of the water used in washing. The literature of the disease teems with illustrative cases.

PREDISPONING CAUSES.

AGE—

Of all ages liable to be attacked by typhoid fever, that of from 15 to 35 is by far the commonest. Some 4/5ths, of the recorded cases are at that period (about ½ before the 25th year), after which the frequency of attacks gradually diminishes, so as to present a remarkable decline about the 40th year—a very small (fractional) percentage being encountered after the 40th year, and an occasional case at the extremes of life. The following table (Schutz - Beitr. zur Statist. des Abdom. - typhus, Jahr.; & Inaug. Dissertat., Leipsic, 1893) will suffice to make this clear.
The above table, together with the voluminous collections of Murchison (Die typhoiden Krankheiten; Zdözer, Braunschweig). Fielder (Arch.f. Heilk., 1862) Greissinger (Virchow's hanb. der. speciellen Pathol., 1864. 2 Aufl. bd. ii.). Liebermeister Ziemssen's handb., 3 Aufl.; bd.ii., Heft. 3.124). Hagenbach (Jahrh. i. Kinderheilk., Neue Folge. 1875, Bd. ix.) and Brouardel (Reparation de la fièvre typhoïde en France, Rec. d. trav. Comité consult. d'hyg. 1891) all serve to demonstrate the important and interesting fact that typhoid fever seldom attacks children before the age of five; after which its morbidity increases as indicated.  

**SEXES**

Both sexes appear to be affected with about equal frequency. True, the morbidity rate is a little higher in males; but from purely extraneous causes as the greater exposure to infection, variation of
residence, and more frequent resort to isolation hospitals, from which statistical information is mainly derived; and which, exclusion of accidental circumstances not being certain, must not be taken as in- fallible.

PUERPERAL STATE-

According to Griessenger and Rokitansky (loc. cit.) typhoid fever is of remarkable rarity during the Puerperium, as well as the period of lactation. Lieb- ermeister (loc. cit.) however, adduces evidence to the exact contrary. The statistics of Ernst (Zeigler's Beiträge, Bd. viii. S., 188) Eberth (Fortshr. d. m. d.) Hildebrand (Iod. , 1889, Bd. vii.) Lynch (J ohns Hop- kins Hos. Bull., vol. xii.) and others, supply somewhat contradictory information; so that the question must be left undecided.

CONSTITUTION.

In marked contrast to typhus, typhoid fever attacks by preference the well-fed, and the well-housed; although common enough amongst those living under adverse circumstances, in person or locality, tending to lower the vitality of the system. Per se, these are not operative, only contribu- utary; as where overcrowding, bad ventilation, and poverty exist, the usual defects of drainage, lack of cleanliness and sanitary routine, will be found also, the ethiological interpretation of the same being obvious. It is nevertheless the better housed and more robust of the working class who are most often attacked by typhoid, in addition, of course, to those in daily contact with the contagium, as nurses, laundresses, medical practiceurs, &c.; these, however, chiefly in hospitals where careless handling of uten- sils, and neglect of rules are noticeable; and to such many recent epidemics have been traced.

The disease being essentially contagious, isolation of patients, though desirable, is not so neces- sary as in the case of an infectious disease proper.

COLD-

Whatever influence this may have been supposed to have had in provoking an attack of typhoid, in view of our knowledge of the disease, it cannot be admitted to have attached to it a definite etiological interpretation, but rather that of a coincident cir- cumstance.

DEBILITATING DISEASE-

Clinical experience seems to point to the fact that during the convalescence from other diseases typhoid fever is very apt to attack the individual, but then only only in a milder form than when affecting a specially predisposed and healthy individual. This view, however, is by no means generally accepted; some holding that during the convalescence from disease a certain immunity to typhoid is displayed.

The fact of smallpox exhibiting a marked anta- gonism to enterica (Gressot- Edin. Med. Jour., July, 1885; and Carnot - Rev. de m. d., 1856) has been taken advantage of by the anti-vaccinators, who hold that by
stamping out smallpox typhoid fever would be allowed full play; but this theory, in view of the frequency of mixed infection and its obvious absurdity, may be dismissed as untenable. (Mixed infections; Lyon - Johns Hopkins Hosp. Rep., vol. vii.)

The presence of wasting disease - malignant tumours, and phthisis - seems to have the property of conferring upon the sufferers an immunity from typhoid, tho' great may be the exposure to infection.

The neurotic constitution, and dietetic errors, cannot be said (though claimed) to confer any kind of immunity; but rather, on infection, to hasten the typhoid attack. Moreover, from what has been noted above, stomach troubles (dyspepsia, dilatation, &c.) attended by a diminished secretion, may reasonably be presumed to play into the hands of the disease, by allowing the speedy passage of the typhoid bacilli to the intestines; and vice versa (Le Gendre - Dilatation de l'estomac et fièvre typhoide, Thèse, Paris, 1885).

Whilst admitting the possibility of an inherited immunity, its probability must be doubted. That one attack of typhoid immunizes the individual from another (for a time at least) has been proved over and over again; but must be subjected to the qualification (contrary to what we find in other specific fevers) that it is seldom permanent; for even after the severest kind of illnesses a person has been known to suffer a second or more times (Beetz - Deut. Arch. f. klin. Med., B.D.xvi., xvii; Freundl.oid., B.d. xxiii; and Quince ibid. B.d. xxix Videque; Eschorst - Virchow's Arch. B.d. cxi., Goth - Inaug. Diss., Kiel, 1886), nor does a first attack necessarily mitigate the intensity of another.

Attempts have been made to immunize laboratory animals by injecting into them serum of typhoid patients (Stern - Deut. Med. Woch., 1892, 37) The experiments of Preiffer and Kolle (Zeit.f. Hyg., Bd. xxii) in this direction are important; and culminated in their being able to isolate, from the blood of typhoid convalescents, specific "antibodies," which, on injection, were capable of immunizing guinea-pigs; and later (Deut. med. Woch., Nov. 12, 1896) similar bactericidal substances, from the blood of human beings (typhoid patients), the protective properties of which are not restricted to the lower animals. This discovery has been extensively utilized in India, as well as during the late Boer war, for the immunization of the troops; with, so far, most encouraging results (Wright and Semple - Brit. Med. Jour., Jan. 30, 1897).

LOCALITY

(1) The localisation-theory. That a local preference on the part of Eberth's bacillus (i.e., a
strictly enteric district) exists - as used to be insisted upon by the ground water theorists - we know not to be the case; unless it be in the form of an infectious water supply, and so forth; facilitating the access of the bacilli to the digestive tract of consumers. The disease may therefore, rage wherever, and whenever, the conditions, local or general, or favorable to the latter essential.

(2) Geographical Distribution - Typhoid fever is a wide-spread disease, and seems to never affect one country more than another. It is just as common in cold regions as in warm ones; and it is met with at the highest altitudes - the well-known epidemic at the St. Bernard, and district. The disease, moreover, exhibits no racial preference, thus differing from certain other infectious maladies (Hirsch-Hist. geograph. Path).

(3) The Acclimatization-Theory - This was promulgated, long ago, from the common observances of new-comers to a typhoid locality so readily contracting the disease, and the cessation of their liability to the same after a period of "acclimatization." The peculiarity, however, is probably not an inherent one, but due; (1) to personal predisposition; (2) age - younger members of the community being oftener on the move than others; (3) possibility of their irregular existence on arrival; and (4) their partaking of (in ignorance) contaminated articles of food or drink.

SEASON AND WEATHER.

(1) Season

That typhoid fever exhibits a remarkable uniformity in its relation to season is well known. It is especially prevalent during the autumn - hence its synonym "autumnal fever" - but, after a severe epidemic, it is not infrequently reported up to the end of December. It is least likely to be prevalent during March, April, and May. The reason for this seasonal uniformity is difficult to explain; the most feasible view is that of some hidden peculiarity in the life of the bacillus causing its multiplication, by preference, during the late summer or autumn.

(2) Weather.

Warmth and dryness seem to have more effect in leading to an increase in the number of typhoid cases in a locality; but the contrary, cannot be presumed to be equally operative, the evidence in favour of either view from time to time adduced being of such a vague and unreliable nature.

SUMMARY OF PRACTICAL POINTS.

(1) Differential.

Typhoid fever differs from other infectious diseases in the following respects;

1. It is of world-wide distribution, and common to all races.
2. Whilst frequently absent from rural districts,
it is nearly always epidemic in large cities, due to the free intermingling of persons in the latter.

3. Its spread is governed by conditions of water-supply, and direct conveyance of infection from disease-foci, and its propagation is accordingly never rapid, as in diseases conveyed by the air.

(2) General.

1. The disease is due to a specific bacillus (never to the colon bacillus) which increases and multiplies in the body of the patient; and disseminates itself by being cast off, by way of the urine and faeces, so as to gain access to the digestive tract of another.

2. It is an essentially contagious disease, mere presence of a person in an infected atmosphere never leading to the disease being contracted, no matter how predisposed the individual may be.

4. Of all means of dissemination of the virus, water-supply is the commonest.

5. Typhoid Fever is never contracted by the inhalation of poisonous gas.

6. The disease affects the robust and healthy-young adults by preference, and is rare at the extremes of life, especially during infancy.

7. It affects both sexes equally.

8. Although the attack usually protects for life, a second has been met with, and exceptionally three or four attacks.

9. In Europe, the disease is much more prevalent in the late summer, the autumn, and early winter months.

10. It tends to spread itself locally.
PATHOGENESIS.

APPEARANCE OF CADAVER.- Should death have taken place at an early stage, from the severity of the symptoms (haemorrhage, &c.), little that is abnormal will be noticed on inspection of the cadaver. On the other hand, however, should death have occurred after a protracted attack, or complications, the body will be extremely emaciated, the skin desquamated, and presenting evidences of the formation of boils, ulcers, joint-swellings, and muscular infiltration. Putrefaction is retarded— or at least does not begin so early as in other disease conditions — and rigor mortis will be of longer duration.

MUSCULAR SYSTEM.
The muscles— especially when death occurs at the height of a severe attack— present a remarkable appearance, like that of smoked meat, and are dusky on section, as well as friable to the touch. These alterations may affect either the entire system; or, more usually, the adductors of the thigh, the abdominal recti, the pectoral muscles (the pectoralis major, according to Cahradnieky— Wien.klin. Rundschau, 1895, 43— being sometimes the seat of abscess-formation), the diaphragm, and, occasionally, the linguales. As in typhus, ante-mortem muscular ruptures, and extravasations, are frequently observed; the first case of this incident being recorded by Velpeau (Dict. Entrente vol. Art. l'Abdom. Rupt.) as far back as the year 1819, being found during the course of an autopsy upon a soldier at Tunis. He considered the lesions to be easily accounted for in view of the fragility of the tissues of the body consequent upon continuance of the febrile state, and the incessant movement of the patient during it. The condition received still further investigation at the hands of Rokitansky (loc. cit. in 1844; Virchow (Wurzburg, Verhandl., vii., & Virchow's Arch. iy. in 1857; and Zenker (Ueber die Veränd. der Willkühl. Muskeln im Typhus. Abdom., Leipzig, 1864); and it is to the interest excited in the phenomenon by the latter, that it has come to be regarded as an almost essential accompaniment of the febrile state in general, and of typhoid in particular. Yet the condition is not confined to the specific fevers, for it is sometimes encountered in such diseases as cholera, pneumonia, dysentery, measles, tetanus, Bright's disease, large ovarian tumours, muscular traumatism, cerebro-spinal meningitis, scurvy, phthisis, and scarlet-inform
affections.

There are two distinct forms of such muscular degeneration; (1) a granular proliferation of the muscular cells; and (2) a waxy change - the former being much less common than the latter; in regard to which it may be noted that, microscopically, the muscles are of a glassy, translucent, slightly opalescent appearance, the fibres being swollen to double their usual size, and converted into fragile cylinders. On being called into action - as by efforts of coughing, defaecation, &c. they rupture with great readiness.

The reason for the change has been, and is being, much debated. Liebermeister (loc. cit.) holds that it is due to the continued pyrexia; Ranvier and Weihl (Virchow's Arch., 1874, 61, 253), Hoffmann (Ibid., 1867, 40, 505) and Waldeyer (Ibid. 1865, xxxiv, 470; & Centralol, med. Wissemsh., 1865, 97), on the other hand, consider it as a direct result of coagulation of the myosin; whereas Erb (Virchow's Arch., 1868, 43, 108), and Bernheim (Gaz. Méd. de Strasb. 1870, 7) consider it to be due to post-mortem imbibition; and Hayem (Gaz. Méd. de Paris, 1866, 6, 698) to an obstructive arteritis. Zenker (loc. cit.), however, contends that it is really a sequel to a degeneration of the trophic centres of the affected muscles.

The arteries being involved in this change, rupture, muscular haemorrhages occur in three forms; (1) Ecchymoses; diffuse muscular soaking with blood; and (3) haematomata. The latter is most common of all and the clot in time tends to suppurate. Affecting the abdominal wall, it has been observed (Grüber - Etude clinique sur les abcés, musc. qui surviennent pendant la convalescence de la fièvre Typhoïde, Thèse de Paris, 1873, p. 42) to burst into the peritoneal cavity. In this case, the abscess is nearly always to be found below the naval, away from the support derived from the linea transversae. Healing of the muscles follows by the ordinary processes of repair.

As noted above, the abdominal recti, and adductors of the thigh, are most of them affected by degeneration and haematoma. Should the diaphragm be involved, the impairment of respiration induced is apt to assume alarming proportions.

Stokes (Cited by De Schweinitz, 5th. Toner Lect., Feb. 17, 1875) suggests that the deafness and hoarseness occurring during the febrile stage of typhoid may be to a similar change in the muscles of the ear and larynx; but the idea, being unsubstantiated by post-morten evidence, must be dismissed as untenable.

Degeneration of the thigh-adductors, followed
by abscess, may produce dislocation of the hip, without the presence of the lesion being suspected by the patient, or the underlying accumulation of pus being suggested to the physician by the usual febrile manifestations. Haematomata of the abdominal recti do not produce flexion of the thigh, no matter if of large size, as their presence may be mistaken for a distended bladder, if in front; for a typhilitis, if in the right iliac fossa; and for a simple abscess when in the adductor region. When small, they are not infrequently obscured by meteorism.

SKELETAL SYSTEM-

The frequency with which the bones are affected during the course of a typhoid attack has been specially emphasized by Keen (Toner Lect., 18761, in the Smithsonian Miscellaneous Collections (No.300), and by others.

The change is of the nature of a necrosis, said to be due; (1) either to thrombosis or embolism; or (2) inanition from defective nutrition; but now recognized as resulting directly from the destructive irritation of the typhoid bacillus - predisposed to, it may be, by the factors mentioned, viz; - local inanition, especially in the presence of anemia; and embolism and thrombosis, by the ordinary train of gangrenous events - particularly by the extension from the soft parts of the osseous neighbourhood (Vide; Mears - Med. Times, Phila., Aug. 28. 1880. p. 608; and Franklin - Lancet, 1897, i., 553.)

Almost any of the bones may be affected; instances of the soft parts being involved likewise having been recorded by Lawton (Lancet, 1879, i., 685) the left lower eyelid and cheek, with necrosis of the left upper jaw and maxillary necrosis with gangrene of the oral mucous membrane by Alexander (Breslauer aeretzlich Zeitschr., 1887, 271). In two instances only has the mandible been seen to be affected (Heath - Med. Times and Gaz., Dec. 18, 1869), and then also accompanied by lesions elsewhere.

Most of the cases recorded, as the above, were studied before the discovery of Eberth's bacillus; and since then, where the organism has not been found, it has probably resulted from defective methods of observation. The colon bacillus - as in the case reported by Klemm (Arch. f. kiln. Chir., 58, heft. 4) - has been in association with it in the pus (the possibility of this, however, has been denied by Dehü (Etude sur le rôle du bacilli. d'Eberth dans les complications de la fièvre typhoïde, Thése de Paris, 1893) & the aureus citreus bacillus by Parsons (Johns Hopkins Hosp. Rep., vol. v). The latter observer has drawn attention to the frequency of the persistence of an open sinus, it may be for years, the pus throughout that period containing Eberth's bacilli in
abundance. Klemm (Arch. f. klin. Chir., Bd. 46) explains this on the grounds of a mixed infection of staphylococci and typhoid bacilli, the former starting the suppurrative process, dying out, and leaving the latter to continue it. The researches, however, of Jnowski (Zeigler's Beitr., 1895., xvii, 221), Dehü (loc. cit.), Vaillard (Bull. Méd., 1892, vi., 1873), Vincent (Ann. de l'inst. Pasteur, 1893, vii, 141), and others, have established the fact of the greater vitality of the staphylocci, and the speedy death of the typhoid bacillus in cases of mixed infection; from which we conclude that when the latter is found in possession of the field, the former had in all probability never existed there.

In spite of this, however, the streptococcus and Eberth's bacillus grow readily side by side, thus accounting for the occurrence of postenteric bone abscesses, due, no doubt, to priority infection with the streptococcus (not at the time recognized as such) followed invasion of the typhoid organism.

As pointed out by Ebermeier (Deut. Arch. Med., 1889, 45, 9), mixed infections, though commonest, are not always etiologic of the sappurrative progress, as these may be due to the pyogenic properties of the typhoid bacillus itself.

That the bones present a particularly inviting field for Eberth's bacillus - even for years after the attack of typhoid fever - there can be no doubt, considering the frequency with which they are found to be affected. This preference for the osseous system is now believed to be due to; (1) the remarkable vitality of the bacillus in general; and (2) its activity in the bones particularly.

As instances by Buschke (Münchener med. Woch., 1897, 26, p. 699), Sultan (Deut. Med. Woch., 1894), Brunh (Ann. de l'inst. Pasteur, 1896, x., 220), Chantemesse (Bull. et Mém. Soc. med. des hop., 1893, x., 779). Parsons (Johns Hopkins Hosp. Rep., v., 417), Pean and Cornil (Bull. Acad. Méd., Paris, 1891, 3d. Ser., xxv., 599), Chantemesse and Widal (traité de Méd., July, 1891, l.), Orloff (Deut. med. Woch., 1890, p. 1906), Klemm (loc. cit.), Werth (Deut.med. Woch. 1893, 21), Berg Centralol. Chir., 1896, 153) Lockwood (Lancet, 1895, i. 531), Rintze and Fraenkel (Centralol.f.Bakter., Oct. 10.1893, 445), in addition to abscess of the bones proper, the bacilli may induce both periostitis and osteomyelitis, and at any time go to six or seven years. On the other hand, however, the bacilli are to be found alive in the bones without causing any disease-process therein (Quincke - loc. cit.) due probably to the resisting properties of the osseous tissues. On this being reduced, from systemic debility, and so forth, the bacilli at once begin to exercise their deleterious action; frequently
started, moreover, by traumatism (Mercier - Rev. Meseuile de Méd. et de Chir., 1879, iii., 21). Typhoid periostitis presents the peculiarity of progression to a certain point, subsidence, and apparent cure, followed by a return of the malady, it may be, years afterwards. Such relapse may be repeated several times (Parsons - loc. cit.).

Still further illustrations of the favourable nidus supplied to the typhoid bacillus in the bones is afforded by the frequent occurrence of multiple abscesses - instead of the single disease-foci, so far described - Vide; Catrin (Gaz. des Hop., 2896, 42), Péan and Cornil (loc. cit.), Mercier (Rev. mens. de Méd et Chir., 1879, iii, 2), Park (Ann. of Surg., 1891, ii., 491), Chantemesse and Widal (loc. cit.), Halin (Contrib. à l'Etude des Complic. Osseuses de la Fièvre Typhoïde, Thèse de Paris, 1885), and Casper-schon (Feilschr. Fr. v. Esmarch, 1893, 445) - with the additional peculiarity of involvement of the various bones successively, and with often long intervals between each; proving that the patient is subject to bone affection as long as the bacilli remain in the system, and his safety only upon their complete eradication.

The phenomenon of the patient's increase in stature (sometime considerable) during the typhoid attack, is to be explained on the ground of the irritation and stimulation of the osteogenetic elements by bacilli, provided the latter are present in too small number to cause actual bone-lesion. The osseous affections have, in a few instances (Routier and Terillon - Progr. Méd., April 12, 1884; and Finlayson - Amer. Jour. Med. Sci., Mar., 1891) been known to arise, by apparent preference, at the site of old strumous cicatrices or fractures, inducing considerable destruction there. Still further, a traumatism may directly provoke an osseous necrosis (Mercier - loc. cit.; Levesque - De la Pér. dans la Conval. de la Fièvre Typhoïde, Paris, 1879; and Carke - Jour. Amer. Méd. Assoc., April 4, 1891, 473.), as in the case of tuberculous bone-lesion after an injury. Experimental evidence of this has been adduced by Colzi (Beitr. klin. Chir., 1895.x.), who found that the injection of a 2.c.c. of a pure culture of the typhoid bacillus, into a rabbit's ear, gave negative results unless preceded by a subcutaneous fracture - when a bone abscess developed in 11 out of the 14 cases studied.

Citzel (Park's Lect.) holds that the frequency of bone disease during fever is further contributed to by the bath treatment, during which the patient comes into contact with the edges of the tub - not necessarily with any appreciable force - in such a way as to constitute traumatism. The sometimes serious effect of
even a slight injury is still further illustrated by Jackson (Brit. Med. Jour., 1885.i., 428), who reports the occurrence of a necrosis of the third rib, from pressure of the stethoscope, five months from the commencement of the typhoid illness the same leaving a permanent soreness there.

The possibility of extensive osseous mischief, even years following the febrile attack, on undue muscular exertion, or slight injury, must be carefully borne in mind by the patient, who, until the certainty of the exodus of the bacilli from his system is assured, should be cautioned to avoid any kind of strenuous effort.

Curiously enough, of all parts of the osseous system likely to be attacked by typhoidal periostitis, the attachment areas of the powerful muscles (anterior superior iliac spine, and ischial tuberosity, for instance) are least so; Sacchi (Revista Veneta, Jan. 1889), and Hulen (loc. cit.), however, report instances. The great Trochanter, the humerus, the inner side of the titia, and the inner femoral condyle, seem to be likewise rare seats of bone mischief, although cases of the conditions are reported by Ebermeier (Deut. Arch. f. klin. Med., 1889, 44. 140). Hulin (loc. cit.), Turgis (Contrib. à l'Etude, &c., Thése de Paris, 1884), and Martha (France Méd., April 4, 1888); whilst that of Verchère illustrates the co-existence of both traumatism and muscular strain as etiologic.

With special reference to the varieties of bone disease in typhoid fever, the essential forms are; (1) Osteomyelitis, and (2) osteo-periostitis (most common), from either of which necrosis, caries, or abscess may result. As first pointed out by Baget (St. Barts. Hosp. Rep., 1876), the ribs seem practically immune from necrosis, which has only occasionally been observed to occur in the costal cartilages - periostitis, osteomyelitis, and chondritis, being the more common typhoid affections of these structures (Berg - Centralbl. f. Chir., 1896, 153; and Belferich - Berlin, klin. Woch., Oct. 20, 1890, 979)

Central bone-necrosis (around the medullary cavity) has been seen only on two or three occasions (Klemm - loc. cit.; and Colzi - Beitr. klin. Chir., 1893,10).

Corbié and réan (Bull. Acad. de Med., 1891.xxv 602) have reported somewhat intractable bone lesion, (termed by Chantemesesse "shirt-stud Abscess" or "bouton de chemise") in which two abscesses are to be found, one under the periosteum, the other in the medulla, with a connecting sinus through the intervening bone.

The fact of males being more often affected than females, is merely coincident, as the lesions exhibit no preference as regards sex.
Age, on the other hand, seems to have some predisposing influence, as according to Paris (Bull. Acad., 1891, xxv., 602), two thirds of the osseous lesions of typhoid fever occur in childhood, and adolescence. It is, however, a noteworthy fact that disease of the ribs, and costal cartilages, almost invariably appear late in life—never before the age of twenty (Helferich—Berl. klin. Woch., 1890, 979).

In contradistinction to what we find in tuberculosis, both periostitis and osteomyelitis of the ribs seems to have no depressing effect upon the general health, the disease being, therefore, entirely local, and unaccompanied by pyrexia, or other systemic disturbances.

Statistics all go to prove that the lower extremities are attacked more often than any other part of the skeletal system, more especially the part of the tibia most free from muscular attachments (antero-internal), due probably to its remoteness from the centre of vascularity, and consequent comparative ischaemia. The foot, however, is but seldom affected (Parsons—Johns Hopkins Hosp. Rep., v., 417), and that from the activity of the circulation in its spongy tissues.

Typhoid bone lesions are nearly always of late appearance, seldom during the febrile stage; never, according to Ebermeier (Deut. Arch. f. klin. med., 1889, 46, 140), before the tenth day, and usually only when the convalescence is well established—due, doubtless, to the patient beginning to walk about, and by so doing attracting the bacilli to the lower extremities, or elsewhere. The experiments of Omochowski and Janowski (loc. cit.) at this juncture are particularly apposite, proving that injection of the bacilli under the sound skin of the limb led to no suppuration unless the part had been debilitated, or otherwise disturbed.

JOINTS.

Typhoid affection of the articular system takes the form of an arthritis, which may be either polyarticular or monarticular.

1. Polyarthritis;—

This form of joint affection is most usually located to the lower extremities; and but seldom leads to ankylosis. Cases of the latter, reported by Despaigne (Lapersonne des Arthrites Infect., p. 120), Gibney (Trans. Amer. Orthop. Assoc., 1889), and Clarke (Jour. Amer. Med. Assoc., April, 1891, 473), were probably due to secondary infection, consequent upon the neglect of extraneous circumstances.

2. Monarthritis;—

The seat of election for this variety of affection is the hip, although it is sometimes encountered in other large joints. It induces marked swelling, unless the same is obscured by large muscles, as at the shoulder and hip. It seldom leads to purulent formation, accounting for the rarity of fistulae in such
cases. A case of the latter complication is, however, reported by Tarbox (New York Med. Rec., Aug. 24, 1889, 889); in marked contrast to that of Dunin (Deut. Arch. f. klin. med., 1886, xxxix., 369) in which the disease was so severe as to produce abscesses of both the hip, buttoc, elbow, shoulder, and innumerable boils, and yet without a single fistulous opening - a perfect recovery resulting.

The frequency of joint affections is, at the best, but small, the literature of the last sixty years or so containing only 100 instances; whereas some of the other writers, as Murchison, do not even sanction it.

Rheumatic Typhoid-arthritis-

Unlike ordinary typhoid-arthritis, this variety is usually polyarticular, and leads, moreover, to frequent ankylosis. The rheumatic history attached to such cases (Despaigne loc. cit., Balzer - Haz. méd de Paris, 1881, 40, p. 559; and Freyheus - Berliner klin. Woch., 1891, 42 p. 1) distinguishes them, and admits of their separate classification.

Septic-Typhoid-arthritis-

Cases coming under this category result from a mixed infection of the typhoid bacillus, the suppurrative processes being nearly always the result of complicating septicaemia. Cases recorded by Robin (Gaz. méd. de Paris, 1881, 559) serve well to illustrate the anatomic lesions, consisting of purulent arthritis of the knee, right ankle, knuckles, right middle finger, and little toes, as well as suppuration of the extensor tendons in the immediate neighbourhood, periostitis of the left tibia, and abscesses about the larynx, trachea, and left costal cartilages, (Videque; Rendu and Menard - Gaz. méd. de Paris, 1881, 559; Tripler - Lyon Méd., 1888, p. 105; Fraentzel - Ein. Fall. von acuten mediatin. in Verlaf. Ileotyphus, Berlin, klin. Woch., 1874, xi, 97; and Werner - Verbriet &c., Med. Corresp. Wartemb. Aestlich. Verein, Stuttgart, 1859, xxxix, 75).

Dislocation of the Hip-

Lancet 1891, p. 901; and Weil - Pra. med. Woch., 1878, 61, as well as in cases of hemipleegia and sciatica (Stanley - Med. - Chir. Trans., xxiv., 1233; Malgaine - Fract. and Dislocat., Paris, ii., pp. 218 - 226, and 882 - 887; and Phocas - Gaz. des hop., 1894, 132 & 135). The exact part played by Eberth's bacillus in the production of joint affections is still doubtful, in spite of the facility with which the effusion can be obtained by aspiration and submitted to bacteriologic examination, with the result, however, that it has never yet been discovered therein. The bacillus has probably been present at the commencement of the disease, but died out, leaving its pyogenic companions in possession of the field.

THE DIGESTIVE TRACT.

1. THE MOUTH AND PHARYNX.

These parts present a variety of, discrete or confluent, rounded and shallow, ulcers, covered by a thin yellowish detachable deposit. The tongue, however, as seldom affected by this degenerative change, although it may be the seat of a form of inflammation, stopping short of actual suppuration. The salivary-glands are found to be enlarged (when death has taken place at an early stage of the illness), hard, dark, and brownish-yellow; and, on microscopical examination, presenting evidences of hyperaemia, and cloudy swelling of the granular cells. The oesophagus itself may be found ulcerated. It seldom proceeds to cicatrization, but cases of this accident have been described by Mitchell (Johns Hopkins Hosp. Rep., vol.viii) and Packard (Phila. Med. Jour., 1898). from the ulcers the bacillus can be isolated, showing their origination as a secondary infection.

11. THE STOMACH.

Compared to the lower part of the intestine, the stomach plays a subordinate part as regards anatomic lesions.

Haemorrhage, from perforative ulceration, has been reported on several occasions, by Cornil (Gaz. hebdom. des Sci. méd., 1890), Chauffard (Thèse de Paris, 1892), Peffer (Amer. Text-Book of Med., i., 91, ii., 769), and Fenwick (Disorders of Digestion in infancy and childhood, 1897,p.256); but haemorrhage from non-perforative ulceration is rare. Typical typhoid ulcers have been occasionally observed in the stomach; but they seldom lead to perforation, the latter being prevented by the speedy formation of protective adhesions to neighbouring organs. The efforts of Cornil (loc. cit.) and Chauffard (loc. cit.) to differentiate a special typhoid gastric affection - in the accumulation of lymphoid tissues - have not met with general acceptance.

iii. THE INTESTINE -

The upper part is, together with the stomach,
of minor interest, the characteristic anatomic alterations of the lower part (lower third of the jejunum downwards) being of absorbing interest; and these only result from the bacilli being allowed to pass the stomach unchanged.

The typhoid lesions of the intestine are so constant as to be regarded as specific, and quite as much so as the various rashes of the acute specific fevers.

The morbid changes in Peyer's patches and the solitary glands of the intestine, can be classified under four stages:

1. The stage of Hyperaemia.
2. Medullary Infiltration.
3. Necrosis or Ulceration.
4. Healing or Cicatrization.

(1) The Stage of Hyperaemia-
This consists of an increased vascularity of the intestinal succus membrane, occupying the first week of the attack.

(2) The Stage of Medullary Infiltration-
At the beginning of the second week - with a coincident subsidence of the hyperaemia and swelling - the medullary infiltration takes place in Peyer's patches before the solitary glands. The lymphoid modules so affected become red - later yellowish-gray - with circumscribed oval, and overhanging margins, and situated with their long axis corresponding to that of the intestine, opposite the mesenteric attachment. The projecting patch may be either smooth, granular, or modular - such irregularities resulting from a lack of uniformity in progression. It should be understood, however, that the medullary swelling may extend from the patch into the adjacent succus membrane, leading eventually to a coalescence of patches, and formation of elongated diseased areas, sore especially at the lower part of the ileum.

The solitary follicles, which partake in this infiltration process, form circumscribed (occasionally, as above, diffuse) red elevations in the midst of hyperaemic areas, in size and appearance similar to a pea, and exhibit the utmost variety as regards distribution, sometimes extending as far down as the rectum. The swelling of the solitary and agminate glands is, however, very brief; not always shows evidence of resolution about the beginning of the second week - sometimes as early as the fifth day of the illness. The infiltration, however, is somewhat more persistent.

(3) The Stage of Necrosis or Ulceration-
Except in the mildest of cases, necrosis is the invariable precursor of the subsidence of the hyperplasia of the lymphoid tissue; and it is supposed
to be due either (1) to the local ischaemia produced by compression of the cell-infiltration, or, as suggested by Mallory (Jour. Exper. Med., vol. iii.), (2) a so-called "anaemic necrosis", induced by the bacillus of typhoid fever itself, leading to exfoliation of the necrotic crusts. (3). A toxine is held to be secreted by Eberth's bacillus, having the property of inducing a proliferation of the endothelial cells (phagocytes) producing swelling of the lymphoid tissue - the subsequent necrosis being due to the formation of fibrinous thrombi - by degeneration of the phagocytic cells beneath the endothelial vessels - leading to occlusion of the veins and capillaries.

The process, whilst not invariably seen in all Peyer's glands, can be studied in its full development in the lower part of ileus; where it will be noticed to be of variable depth, from a more superficial involvement of the mucosa, to an actual perforation of the peritoneal coat - the destructive action, however, usually stopping short of the muscular layer.

When fully formed the necrosed area separates, leaving the typical typhoid ulcer (in size and shape corresponding to the exfoliation), the entire process taking from about the 8th or 10th day of the illness to the 21st for its completion.

Each gland of the Peyer's patch shows several ulcers, of irregular outline, and separated by strips of mucous membrane; and it is common, even at the lower end of the ileus, to find a coalescence of ulcers; which, however, is sometimes so complete as to encircle the intestine at the part. The ulcers are smooth, rounded, and with irregular engorged, overhanging edges. They are sometimes very numerous in the lower part of the ileus, the Peyer's patches of the upper part of which, by a mere hyperaemia, perhaps, indicating what might have happened there had the destructive process been allowed to fully develop.

In about one-fourth of the cases the ulcers may be found in the caecum and colon, rarely the appendix; but perforation of ulcers in these parts is exceptional.

Bearing in mind the inequality of distribution and development of the exfoliation process displayed in a Peyer's patch, the fact of the sloughs seldom being cast off in one piece, or in regular particles, can be readily understood. So constant is this peculiarity of exfoliation that the term "plaques ganéés" has been applied to it, in contradistinction to "plaques dures" - the designation for the condition, of very rare occurrence, when the exfoliation of the sloughs occur as a whole, in dense and deeply infiltrated areas.

The ulcers of the solitary follicles seldom exceed \( \frac{3}{4} \) inch in diameter; and, in exceptional cases,
instead of being longitudinally directed, are actually transverse to the long axis of the gut sometimes causing serious stenosis on contraction.

The rarity of perforation has already been alluded to; and it remains to be noted that when it does occur it is due to ulceration of the serous coat, by gradual increase in depth of the ulcer, and its rupture from irresistible pressure of the intestinal contents. Should a largish blood vessel be involved in the ulceration, it may burst and cause alarming haemorrhage; but this more commonly when the plaques are exfoliated entire.

(4) The Stage of Healing or Cicatrization.

This stage quickly ensues upon completion of the foregoing, the floor of the ulcer being gradually covered with granulations, healing from the periphery to the centre, and in so doing dislodging the necrotic crusts, or their remains. The ulcer may, however, heal in one direction, and spread in another - the ultimate cicatrix presenting a smooth appearance.

Thus the fourth stage is usually tardy, and occupies more time than the other three. In weakly persons it may be considerably protracted beyond the ordinary - this condition at one time going by the name of "stonic ulceration."

It is noteworthy, however, that both the amount of medullary swelling of the lymphoid structures, and sloughing of the same, are considerably less in children than adults, thereby explaining the rarity of haemorrhage in the former, in whom also subsidence of the medullary swelling occurs with marked celerity.

In the majority of cases of typhoid fever, we have the intestinal lesions manifested to the above degree; but, just as in diphtheria the amount of throat affection may be hardly noticeable, we sometimes meet with an enteric case in the post-mortem room presenting very little in the way of anatomic lesion that would, by its location to the intestine, confirm the suspicion of its being due to Eberth's organism. The failure to detect definite intestinal lesions in fatal cases of enterica - by no means frequent - is now supposed to be due to defective bacteriologic procedure.

Mesenteric Glands

Changes in the mesenteric glands occur simultaneously with those in the intestines (in associated areas), with which they have the most intimate relationship; the intensity of the affection of the one being in direct proportion to that of the other, and of similar pathogenesis. They have, in severe cases, been observed by myself to be swollen to the size of a hen's egg. Necrosis, and exfoliation, are common, but usually progresses to resolution. Abdominal abscess, however, from a suppurative affection of a mesenteric

The enlargement of the mesenteric glands, is by no means located to the immediate vicinity of the intestine, as it has been known to spread as far as the gastric, portal, retro-peritoneal, and bronchial regions; and, in rare instances, to the glands of the mouth, larynx, neck, and groin.

On section, the engorgement of the glands is most noticeable towards their periphery; which appears reddened, with the medullary part brownish-yellow.

IV. THE LIVER AND BILIARY SYSTEM.

The obvious and intimate relationship between the intestines and the portal system requires no explanation; in view of this, the paucity of cases, illustrative of typhoid lesions in these parts, is remarkable. Hülscher (Münch. med. Woch., 1891, 4 & 5) found parenchymatous degeneration of the liver in over 10% of his 2000 typhoid autopsies, the fatal result in which being presumed by Fränkel and Simmonds (Die. Ätiol., Bedent. a Typhusbacillen, Leipzig, 1886) to have been due to thrombosis of the hepatic vessels from irritation of the typhoid bacillus.

Typhoid abscess of the liver, when found, is usually primary; but the presumption of its invariable, and direct, origination from the destructive action of the typhoid bacillus has not yet received the necessary bacteriologic confirmation. The colon, and the pyogenic, bacilli are, in the majority of instances at least, probably the exciting agents; as suggested by Romberg (Berl. klin. Woch., 1890, 192), who was able to isolate the staphylococcus from the abscess contents. Nevertheless, Dupré succeeded in obtaining a pure culture of the typhoid organism from the latter, six months after the commencement of the convalescence.

Instead of being always a primary occurrence, hepatic abscess - as first demonstrated by Louis (Recherches Anat. Path. et Therap. sur la Fiebre Typhoïde, 1841, 12th. Edn. p. 118) - may be secondary to lesion elsewhere, and, therefore, of essentially pyaemic origin. Romberg (Berl. klin. Woch., 1890, 192) has reported two cases of this; one consequent upon abscess of the ring-finger; the other from a thenar abscess; whilst Chvostek (Allg. Wien. Zeit., 1886, 37), and Burder (Lancet, 1874, ii., 552), have encountered hepatic abscess secondary to laryngeal perichondritis.

Solitary abscesses are of comparatively rare occurrence in enteric fever; but a few examples are mentioned in the literature, by Delaire (Gaz. des hop., 1869, No. 23, p. 20), Langenbuch (Deut. Chir. Lief., 45 c Häfte, 238), and Hülscher (loc. cit.)
Suppurative pylephlebitis has but rarely been observed at typhoid autopsies, and is then found to have resulted from bacterial thrombosis of the portal vein; as proved by Buckling's (Falle v. Leber Abscesse, Berlin, 1868) and Homberg's (loc. cit.) cases - the latter finding the staphylococcus in both the thrombi and the abscess.

Osler (Trans. Assoc. Amer. Phys., 1897, xii., 382) testifies to its rarity, having seen only a single case, and that one in which multiple, and markedly-fluctuating, abscesses occurred in the mesentery - outside the liver the portal vein being represented by an elongated abscess with thick irregular walls.

Lannois (Rev. de Méd., 1895, 909), and others, have been impressed by the hopelessness of such cases, the former describing the cases of a man, aged 38, who died three days after admission, the autopsy revealing adherent (ante-mortem) clots in the components of the portal venous system, with numerous abscesses in the liver - each one containing Eberth's bacillus in association with pyogenic organism.

Wagner (Arch. de Heilk., 1860) has drawn attention to a supposed specific pathologic finding, viz; that of interacinous small, grayish nodules in the liver-substance, which he regarded as analogous to the lymphoid hyperplasia of the intestinal glandular structures. These have, however, been observed in other infectious diseases; and are considered by Reed (Johns Hopkins Hosp. Rep., vol.v.) and others, as merely of the nature of polymorpho-nuclear leucocytes which have wandered into the disintegrating area, from the irritation of the bacillus, or of its toxine.

Mallory's theory (Jour. Exper. Med., vol.iii) of there being two kinds of focal lesions - viz; (1) the production of phagocytes in the immediate neighbourhood of the portal vessels, and (2) embolism of the portal vessels by the cells derived from the endothelium of the intestinal splenic, vessels - has been disproved by Reed (loc. cit.)

THE GALL BLADDER.

The relative frequency of typhoid affection of the gall-bladder is striking, and emphasised by the writings of Chiari (Ueber Cholecystitis Typhosa - Prag. med. Woch., 1893, 22), Dupré (Les infections Biliares, Thèse de Paris, 1891), and Hagenmüller (Cholecystitis Typhosa - Ibid., 1876).

Gilbert and Girode (Contrio. à l'Etude Bakter. des Voies Biliaires, Mém. de la Soc. de Biol., 1890; La Sem. Med., 1890,58; Ibid, 1893, p. 956) were the first to demonstrate the presence of Eberth's bacillus in suppurative cholecystitis in the gall-bladder; not only during, but as long as 14 years after, the typhoid illness. Dupré (loc. cit.) Chantemesse (Traité

Many have indeed come to regard the gall-bladder as one of the surest places from which to obtain a pure culture of the typhoid bacillus. Blackstein (Johns Hopkins Hosp. Bull., Aug. 19, 1891, p. 121), however, was the first to demonstrate experimentally the presence of Eberth's bacillus in the bile of a rabbit, as long as 128 days after its recovery from the inoculation.

This almost constant, and peculiar, affection of the gall-bladder is responsible for the suggestion of Chiari (loc. cit.) that relapses may be directly attributed to it, by means of the induced and increasing flow of infected bile into the intestine upon the patient's return to full diet - failure of the immunizing properties of the blood-serum being, of course, presumed.

Not only does the bacillus reach the gall-bladder, and thrive in the pus, but it seems to find a favourable nidus in the wall of the viscus itself; for Chiari (loc. cit.) found it to have induced fatal necrosis, and peritonitis whilst existing there.

Eberth's bacillus has also frequently been found in gall-stones; in Milan's case 25 stones were found, from each of which a pure culture of the bacillus was obtained; but his suggestion of such a numerous formation, in 16 days only, being due to the irritant action of the typhoid organism, is generally discredited.

Fournier, again, found both the colon and the typhoid bacillus in 38 out of his 100 cases of gall-stones; and believes that an anglocholitis is induced, either by the infection of the bile, or the deposition in the form of stones. The former theory is substantiated by both Gilbert and Domenicini (Soc. de Biol., June 16, 1894) and Hanot (Bull. Méd., Jan. 22, 1893) all of whom found Eberth's bacillus as the nucleus of the gall-stones. The finding of both the Eberth's and the colon organism in the gall-stones themselves, suggests the probability of their being etiologic.

That mixed infections are not infrequent is borne out by Létienné (Arch. de Méd., exper., 1891) who found also the colon bacillus in 24 out of 42 cases; and Flexner (Trans. Assoc. Amer. Phys., 1891, xii 382), who out of 14 cases of mixed infection, found Eberth's bacillus in 7, the colon bacillus in 3, and the streptococcus pyogenes, and proteus vulgaris, once.

The bacilli are supposed to gain access to the gall-bladder either by means of the bile ducts opening into the intestine - the infection being an ascending one, or through the agency of the circulation.
Notwithstanding all that has been said to the contrary, there seems every probability of the bacilli being able of themselves to produce cholecystitis, empyema of the gall-bladder, or ulceration, independent of gall-stones. Hernheim (Dict. Ency. de Dechambre, 1889, Art. Octère), moreover, suggests that the bacilli frequently are responsible for the formation of the gall-stones by producing stasis in the bile, as evidenced by biliary colic during or after the typhoid attack, and the obtaining of a pure culture from the gall-bladder at the operation for relief of the condition. Dufourt (Rev. de Méd., 1893) found gall-stones in 19 patients so treated, from 2 to 10 months after the establishment of the convalescence.

That perforation of the gall-bladder can occur has been evidenced at several necropsies, the findings bearing out what has been already said regarding inflammatory mischief, in that viscus, necrosis or ulceration in its walls, and concomitancy of stones. Cases illustrative of the accident have been reported by Williams and Shield (Lancet, 1895,i., 584), Alexief (Jour. Dietskaza, 1896, No. 4), Osler (Trans. Amer. Assoc. Phys., 1897, xii, 38) and others.

THE PANCREAS.

Little that is unusual has been reported in the way of pancreatic lesions in typhoid fever, beyond slight enlargement and hyperaemia, recorded by the older writers, as Röderer and Wagler (De Morbo mucosa, Göttingen, 1762), who also mention fatty degeneration as an exceptional finding.

THE VASCULAR SYSTEM.

A. THE HEART.

1. The Myocardium;

The condition of the myocardium should death have taken place during the earlier part of the illness, which is far from usual - consists of an increased friability, fibrosis, discolouration, and on the left side - dilatation; these changes, however, being rather more constant in later stages of the fever (Laennec - Traité de l'auscultation médiate, 2nd. Edn. 1826; Virchow - Article on Parenchymatous Inflam. in Virchow's Arch., Bd. iv.; Bütcher - Ibid., Bd. xiii; Waldeyer - Ibid. Bd. xxxiv.; Hoffman - loc. cit.; Hayes - Arch de Phys. norm. et path., 1870; and Rosenberg - Arteit a.d. med. klin. z. Leipsic, 1893).

Hyaline, fatty, and waxy degeneration, have been observed; as well as the peculiar phenomenon of elongation or distension of the nuclei - with abundant pigmentation - to which attention was first drawn by Homburg. The muscle fibres themselves present an appearance as if transversely torn in several places.

These appearances of parenchymatous myocarditis, however, are not necessarily suggested by clinical
symptoms; and are observable on both sides of the heart - the right especially - and towards the apex and base. Appearances of true interstitial myocarditis have been occasionally observed, and of the ordinary kind; but, in addition to this, Hayes (loc. cit.) has directed attention to the peculiar form of oblitative endarteritis, which is claimed to be especially common in cases dying suddenly from collapse, and situated in the intima of the arterioles of the myocardium, leading to narrowing of their lumen.

Although interstitial myocarditis usually heals well, a few instances of permanent fibrosis of the myocardium have been described; but never abscess of the latter; which is strange considering the frequency of myocarditis, and the fact of Eberth's bacillus having been discovered amongst the cardiac muscular fibres (Chantemesse and Widal - Gaz. hebd., Mar. 4, 1887, 146).

2. The Endocardium-

Curiously enough - in view of what we know happens in other fevers - endocarditis with subsequent valvular lesions is extremely rare in typhoid fever; but when it does occur, the bacillus can be obtained in pure culture from the affected valve at the autopsy; and sometimes pyogenic bacteria as well.

3. The Pericardium-

It is quite an unusual thing to find evidence of pericarditis at an autopsy. Cases of the affection have, however, been reported by Weintraud (Berl. klin. Woch., 1893, xxx, 345), Zeller (La France Méd., 1881), Le Clerc (Ibid. 1881, 54), and Driguet-Michon (Contrit. à l'Étude des Suppurat. dans la Fièvre Typhoïde, Thèse de Lyon, 1890).

B. THE BLOOD VESSELS.

The arteries are less frequently affected than the veins; and have been found to be the seat of two forms of inflammation; (1) acute oblitative arteritis, and (2) partial arteritis. These conditions, whilst usually affecting the smaller vessels, are most commonly encountered, in the arteries of the lower extremities, where it sometimes (but rarely) leads to spontaneous gangrene. The veins, on the other hand, are much more often the seat of phlebitis; and the phlegmasia-dolens of the typhoid convalescence is due to it.

THE SPLEEN.

Enlargement of the spleen occurs so often during the course of typhoid fever that it has come to be regarded as characteristic of the malady; and Eberth's bacillus has been found in it by numerous observers, notably the following; Ohlmacher (Jour. Amer. Med. Assoc., Aug. 28, 1897, xxix., 419), Flexner (Jour.
The bacilli are to be found, during the febrile stage, in great abundance, and exhibiting peculiarity in their distribution; in that of innumerable irregularly arranged groupings, in which they lie so close together that, in unstained sections, they appear as dark opaque soots, at the periphery of which individual bacilli may be recognised.

In view, therefore, of the constancy of the invasion of the spleen by the bacilli, it is a matter of surprise to find splenic abscess so seldom at necropsies of typhoid patients (Flavio - Gaz. degli Ospit., in Dublin Jour. Med. Sci., Nov., 1890, 445; Dunin - Univ. Med. Mag., Sept. 1895, 909; Vincent - Merc. Méd., Feb. 17, 1892, 73; and Griesinger - Infect. Kranhk., Virchow's Handbuch Path., 1857.) The spleen in these cases behaves in a manner similar to that of the intestinal lymphoid tissues; and from a preliminary hyperaemic condition, becomes soft and granular. Splenic rupture, however, is of rare occurrence, only five cases being encountered amongst the 2000 necropsies at the Munich Pathologic Institute.

The enlargement of the spleen which occurs during typhoid fever is seldom considerable; but it has been seen in severe cases to enlarge to double or treble its normal size, the hyperaemia and hyperplasia leaving the organ of peculiar tough consistence.

THE URINARY SYSTEM.

THE KIDNEYS.

Like the liver, the kidneys sometimes exhibit parenchymatous degeneration; and are pale, cloudy, and slightly swollen. Microscopically, will be noticed granular and fatty changes in the cells of the convoluted tubules.

In rare instances, an actual haemorrhage nephritis may be found. Again, small areas of round-cell infiltration may develop late in the typhoid attack; and these may eventually undergo softening and suppuration, giving rise to milliary abscesses.

The mucous membrane of the renal pelves may be the seat of a mild form of catarrh, or present membranous inflammatory deposits. The appearances described are most frequently found in the class of cases
termed by the French authors "nephro-typhoid."

Von Richlinghausen (Verhandl. i. physik-med. Ges. z. Wurzburg 1871) and Wagner (Zeitmsen's Handb. der. spec. Pathol., Bd. ix., 3 Aufl., 1 Th.) have also described a peculiar form of typhoid nephritis proceeding to the formation of an abscess, the size or a pea or walnut, by means of the coalescence of numerous minute interstitial miliary purulent foci; such undoubtedly being, in the majority of instances at least; of pyaemic origin; but occasionally also, as contended by Recklinghausen, due to the pyogenic action of the typhoid bacillus itself, which Flexner (Jour of Path. and Bact., 1895, vol. iii) has been able to obtain, in pure culture, from the renal pus; as have likewise Faulhaber (Beitr. path. Anat. und. Allg. Patn. x.), Koujojelf (Centralbl. f. Bakter. und Parasit., 1889), Vincent (Merc. Méd., Feb. 17, 1892, 73), von Wuncheim (Pra. Med. Woch., 46, 1894), Seitz (Centralbl. f. Bakter. ii., 1887), and Neumann (Berl. klin. Woch., 1890).

THE URETERS.
These seldom exhibit any change in their mucous membrane, beyond a slight bleeding point here and there.

THE BLADDER.
Cystitis has been occasionally observed, which, however, is but seldom haemorrhagic, and rarest of all, of a diphtheritic kind, the same eventually giving rise to perforative peritonitis. The possibility of such being due to catheter-infection has been pointed out by Brown (Med. Rec., Mar. 10, 1900)

The Urine in Typhoid Fever.
The following writers testify to the presence of Eberth's bacilli in the urine of great numbers during the typhoid seizure; Karlinski Pra. med. Woch., 1890, xx., 437), Bourchard (Rev. de Méd., 1881, 671), Kanthack and Tickell (loc. cit.), Wissokowitsch (Zeit. f. Hyg., vol. i. p. 11), Seitz (Bakt. Studien z. Typhusaetiö., 1886). Hueppe (Fortschr. d. Med., 1886, 4.47), Koujojelf (Centralbl. f. Bakter. u. Parasit., 1889, vi., 24, Neumann (Berl. klin. Woch., 1888, 7., 1890, 6), and Faulhaber (Zeigler's Beitr. path. Anat.u. Allg. Path., x. 1891). They do not seem, however, to exert any injurious influence there - a cystitis having very rarely been seen at an autopsy - though such might be suggested by the occasional finding of a few pus-cells. To this phenomenon of the presence of the bacilli in the urine without associated cystitis, the term "bacilluria" has been given; and it occurs in about 35% of all typhoid cases. Young (J-ohns Hopkins Hosp. Rep., vol. iii) demonstrates the possibility of their persistence in the urine, by finding chronic...
typhoid cystitis in one case seven years after the febrile attack. Horton Smith (The Typhoid-bacillus and Typhoid-Fever, London, 1900), however, contends that cystitis from bacilluria is possible only when the bladder wall is either damaged, or has to contend against retention.

THE SEXUAL ORGANS.
A. In the Males-
Gangrene may be found affecting the male genitals; but only very occasionally, and then usually secondary to the same condition in the feet (Tunis-Univ. Mag., 1889, ii., 195). With the exception of tissue destruction, nothing special follows, leaving out of the question, of course, the possibility of fatal haemorrhage as recorded by Murchison (Fever, p. 194).

Prostatic abscess has been described by Andrew (Lancet, 1871, ii., 712); and Urethritis by Melpean (Ann. des Org. Ento¬turn., 1890, vii. 291), both of which are the rarest possible findings.

Orchitis and epididymitis are not so common as might be supposed; the former having been recorded, as long ago as 1844, by Velpeau (Dict. en Trente, vol. Art. Testic); whereas Eberth's bacillus has been found, by Déhu (loc. cit. p. 82) and Gasser (Arch. de Med. et de Pharm. Milit., 1895, 3, 228), in both the testicle and the epididymis.

Girode (Arch. Gén., 1892, 169, 43). has described how at the autopsy of a man, aged 29, he found interstitial suppuration, and obtained a pure culture of the bacillus from the pus, and observed that spermatozoa were absent elsewhere. Cases of suppurative orchitis are also recorded by Travel (Corresp. Schweir. Aerzte, 1887, 590), Meultrier Pein, Thèse de Paris, 1890, 18), Gasser (loc. cit.) Bouchut (Revist. Gen. Ital. Clin. Med., 1890, No. 20), all of whom obtained the bacillus in pure culture, and observed the epididymis to be unaffected. The disease is supposed to be due, not to thrombosis of the spermatic veins, as suggested by Widal (Bull. Soc. Clinique, Paris, i., 142), but to the direct action of the bacillus itself; after gaining access to the testicle - either from the urine, in which it has been seen to exist in great abundance, or by infection from the blood.

B. In the Female.
The female genitals, owing probably to their neglected condition, and soiling with discharges of these parts, suffer much oftener than those of the male during a typhoid attack.
Gangrene of the labia has been reported by Soillmann (Arch. Gén., Feb. & Mar., 1881), who states that it extended to the perineum and thigh, as well as the lumbar region and back. Gueneau de Mussey (Gaz. Hebd., 1867, 652) has seen gangrene of the external genitals with ulcers in the vagina, leading to its occlusion and retention of menses; and Martin (Centralbl. f. Gynäkol., 1881) sloughing of the upper part of the vagina and the entire cervix. Vaginal ulcers are usually to be found in the posterior wall, and leading sometimes to fistula (Lebert - Anst. Path., ii. 307), and pelvic peritonitis. Sloughing of the large part of the recto-vaginal septum, en masse, has been reported by Liebermeister (Ziemssen’s Cyc. vol. i., 184), leaving a large fistulous opening; and Schick (Wien. klin. Woch., 1892, vi., 413) vesico-vaginal fistula, with gangrene of the vulva.

In view of the comparative frequency of involvement of the testicle, it is remarkable how seldom abscess of the ovary, or other typhoid lesion has been encountered. Anger (Bull. Soc. Anat., 1865, 364), however, reports a case in which both broad ligaments were the seat of abscess formation; and Sadeck (Münchener med. Woch., 1893, 21) the finding of Eberth’s bacillus in the pus of an ovarian abscess.

Werth (Deut. med. Woch., 1893, 21), and Pit‘na (Centralbl. f. Gynäkol., 1897, p. 1109), in addition to Sadeck (Münchener med. Woch., 1896, 21, 498) state that they found suppuration to have occurred in an old ovarian demoid, from the contents of which a pure culture of Eberth’s bacillus was obtained.

The occurrence of pyosalpinx has been demonstrated by Mabit (Nouv. Arch. d’Obstet. et de la Gynéc., 1893, viii, 267). It is, however, exceedingly rare.

Signs of abortion have been found at typhoid autopsies by Freund and Levy (Berl. klin. Woch., 1895, 25.) and Janizewski (Presse Méd., Mar. 24, 1894), who also report the finding of the bacillus in the spleen and heart of the foetus, thereby proving ante-natal direct transmission from mother to child by vascular agency. Similar cases have been reported by Chantemesse and Widal (Gaz. hebdo., Mar. 4, 1887, 146), Hildebrand (Fortsch. med., 1889, vii., 329), Eberth (Ibid., vii., 5) Beitr. path. Anat. u. Allg., 1890, 8. p. i.), Etienne (Gaz. Hebdo., 1896, No. 16), Janizewski (Münchener med. Woch., 1893), Frascanni (Jahresb. Fortsch. Path. Microbg., 1892), Neuhauss (Berl. klin. Woch., 1886), Reher (Arch. exper. Path. et Pharm., xx., 420), Giglio (Centralbl. f. Gynäkol., 1890, No. 46), Flexner (Zeigler’s Allg.
Pathol), Dmochowski, Janowski, and Hirschel (3 monographs), all of whom testify to the finding of the bacillus in the placenta, bearing upon the subject also is the case of Griffith (Med. News. May 15, 1897), who describes the birth of a child at term during the typhoid illness of the mother - presenting appearances of the fever having been contracted in utero. Etienne's experience (Brit. Med. Jour. Epitome, 1896, ii., 35; from Gaz. Hebd., 1896, No. 16) is even more remarkable; and was that of a necropsy upon a foetus born on the twenty-ninth day of typhoid in the mother. The child's spleen and intestines, as well as other organs, showed no sign of disease, and the placenta appeared to be normal. Blood from the right side of the heart, and from the spleen, liver, and placenta was carefully examined, & cultures made; with the result that the bacillus was found in abundance; so that it was very naturally surmised that the foetus had died from blood-poisoning induced by a large dose of the bacilli, before the occurrence of any local change.

Inflammation of the glands of Bartholin is one of the rarest of all findings; a case of it is reported by Spillmann (Arch. Gén., Mar., 1881).

Guyot (Etude sur l'Hématocèle périuterine survenant dans le cours ou dans le convalescence de la fièvre typhoïde, Thèse de Paris, 1879), states that he has seen Periuterine Haematocèle seven times; and Trousseau (Clin. Méd. Hotel Dieu, 1865) the same condition once.

THE RESPIRATORY ORGANS.

I. THE NARES.

Catarrh of the nasal cavities is common - especially about the turbinated bones and septum; and, if epistaxis has occurred during life, the mucous membrane will be found to be in a state of suffusion or necrosis. Rarely do we find membrane deposited; and then always in association with croupous deposits upon the faeces.

II. THE LARYNX.

The larynx frequently presents appearances of anatomic lesion; but, curiously enough - with the single exception of the bacteriologic examination described by Schulz (Berl. klin. Woch., 1894, Bd. xxxi., 16), and, perhaps, the very doubtful, and incompletely reported, experiences of Luscatello (Ibid., Bd. xxxv., 34) - the typhoid bacillus has not been discovered there.

The laryngeal lesions observed at typhoid autopsies may, for convenience of description, be arranged in three categories, viz: - (1) Oedematous laryngites; (2) laryngeal perichondritis. But, it must be remembered that these frequently overlap one another. The first alone may be observed; the second may deepen so much as to involve the cartilage.
whilst the third may suppurate or ulcerate. Oedematous laryngitis, pure and simple, from venous thrombosis, has been succinctly described, with illustrative cases, by both Emmet (Amer. Jour. Med. Sci., July, 1856, xxxii., 63), and Buck (Trans. Amer. Med. Assoc., 1845, 135); but the conditions sometimes observed point distinctly to its being secondary to erysipelas, parotitis, or laryngeal ulceration. The remaining varieties, so often merging into one another, have, as regards etiology, been much debated—some holding that the ulcers arise from a peculiar form of typhus, named by them "laryngo-typhus", whilst others, again, deny their being of specific origin, contending that they are part and parcel of the common train of septic manifestations, in which low grades of inflammation readily proceed to either ulceration or gangrene. The possible origin from local stasis or thrombosis in the laryngeal vessels has also been suggested.

Instances of laryngeal ulceration are frequent in the literature. Hoffmann (Veränd.d.Organ. beim Abdom. Typhus) found them in 28 out of 250 necropsies; and Griesinger (Infekt. Krankh., 1857, Bd. ii., Abth. ii., s. 160) in 31 out of 118. Louis (loc. cit.) is so convinced of their diagnostic value, as to contend that when found in the larynx of one who has died of an acute disease, they will, with almost perfect certainty, and without going any further, reveal the fact of the fever having been typhoid. Nevertheless, it must be remembered that one may conduct typhoid autopsies for almost a lifetime, and never encounter them.

When the cartilages are involved in the ulcerative process, it is said (Moritz-Haller - Deslerr. Zeitschr. prakt. Heilk., 1856, 19) to be by means of direct extension of the ulcerative process from the laryngeal mucous membrane. The theory of their being, on the other hand, secondary to a similar process elsewhere has been vaunted also; and both having received substantiation, may in certain instances be regarded as etiologic.

Should death have occurred early, a submucous abscess will be found surrounding the ulcerated cartilage, and without opening into the larynx—the latter being observable at a later stage, and in the presence of deep ulceration.

Laryngeal stenosis is, in rare instances only, a post-mortem finding in the case of children. In males, from 15 to 25, it is more common, and is predisposed to by over-use of the voice, and imprudent exposure to atmospheric inclemencies; in the case of females, it is an exceptional finding. No matter when encountered, it will be found to have originated in one of five ways: (1) As in Hoffmann's
case (loc. cit.) from shreds of sloughing tissue in which the blood congealed so as to form a polyp; 
(2) swelling produced by an abscess in the proximity of the cartilage; (3) simple edema; (4) destruction of the origins and insertions of the laryngeal muscles (intrinsic), leading to approximation of the vocal cords; or (5) destruction of the cricoid, in pieces, terminating in falling together of the glottis.

The stenosis, moreover, occupies one of three situations; (1) Usually, and when due to ulceration, or arytenoid perichondritis—above the glottis in the ary-epiglottidean fold; (2) when due to cricoid necrosis or perichondritis—below the glottis (Russell - Glasg. Med. Jour., Feb., 1871, 209); or (3) in the glottis proper; in that order of frequency; and nearly always towards the close of the febrile stage, or at the beginning of the convalescence.

The ulcers present peculiarity or "Orientation" for they are, almost without exception, posterior; due, as Rheiner (Beitr. zur Histol. des Kehlkopf., Würzburg, 1852) first pointed out, to the greater vascularity of that part (as proved by ossification commencing there as early as the twentieth year), contributed to by the dorsal decubitus of the illness. Emphysem is occasionally produced by perforation of the mucous membrane by these ulcers; the same having been seen—chiefly in children—by Wilks (Med. Times and Gaz., 1862, ii., 276; and Trans. Path. Soc., London, 1857, ix., 34.) Steiner (Dis. of children, 1874, 363), and Loeschner (Pra. Vierlejahr. 1856, iv., 23).

Necrosis of the Laryngeal cartilages, being nearly always fatal (Turck - loc. cit., p. 223; Hérald - L'Union Méd. July 14, 1859; and Trousseau - Clin. Méd. Sydenh. Soc. Trans., 2nd Edin., vol. ii. p. 407), must be specially looked for, and will, in the majority of instances, be found in either the cricoid (Lüning - Arch. f. klin. Chir., 1884, xxx., 225), or the arytenoids—the former usually, the latter seldom.

The necrotic process, however, induced, leads to a speedy disintegration of the cartilages; occasionally ossification; and, still more rarely, caseation. The articulations of the cartilages may be completely destroyed, especially those of the cricoid; and if the abscess has been about the latter, it may be found to have burst into both the larynx and pharynx, establishing fistulous communications between these parts (Dittrich - Prag. Vier. Vier. Tercerjan., 1850, iii., 117).

Armstrong (Prac. Illust. of Typhoid Fever, 1819, 399) reported the occurrence of a retro-pharyngeal abscess— a rare finding, but, short of that,
a pharyngeal ulcer, may result from the pressure of the swollen cricoid upon its adjacent wall, aided by the foul discharge. Hoffmann (loc. cit., p. 338) relates how he found a retro-pharyngeal abscess extending from the base of the skull to the diaphragm, laying bare the subclavian artery.

The epiglottis, again, may show ulcerative lesions about its margins—separately or in groups, superficial, or extending deeply into the cartilage, causing its exfoliation in patches, or, more rarely, an extensive destruction.

In very exceptional instances thyroid perichondritis, and necrosis may be found.

III. THE TRACHEA AND BRONCHI-

The trachea and bronchi seldom present evidence of anything abnormal, beyond, perhaps, indications of minute erosions or ante-mortem catarrh; whilst perichondritis, necrosis, suppuration, membranous deposits, and extensive fibrinous tracheo-bronchitis, are the rarest possible findings.

The bronchial glands may be found to be in a state of hyperplasia, as part of the general glandular hyperplasia of the fever, and quite independent of the other bronchial lesions described.

The bronchioles are to be found at times in a state of slight catarrh (considered by some authors, e.g. Finkler — Die Acuten Lungen, Wiesbaden, 1891; 1891; and Polynère — These, Paris, 1889 — to be specific — and peculiar to typhoid fever), which may have associated with it atelectasis, or lobar pneumonia — due to bacterial (typhoid or other) irritation.

IV. THE PLEURA AND LUNGS.

A. The Pleura-

The pleural cavity was one of the first regions in which Eberth's bacillus was discovered, De Gennes (La France, Méd., 1885, ii., 1821), in 1885; Fraenkel (Verhandl. Sechste Kongress inner Med., 1887, 179), and later, Remlinger (Rev. de Méd., 1900, No. 12) obtaining pure cultures of the bacillus from cases of recent pleural effusion.

Pleural affections (pleurisy or empyema) are most usually found to occur either in the third week, or as late as from one to two months after the fever. In Rendu's case (Up. cit., 1885, ii. i.m. 1809) the empyema followed a pneumothorax on the thirty-eighth day of the convalescence. Ramsay (Ann. Surg. Jan., 1890, 39) found it in connection with abscess of the lungs, and abscess of the spleen; and Barr (Liverpool Med. - Chir. Jour., 1893, xiii., 346) with purulent anterior mediastinitis. Fraenkel (loc. cit.) described having found empyema in four cases out of five hundred of typhoid fever, the cultures obtained demonstrating the presence of Eberth's bacillus in four; the streptococcus in the third, and
the pneumoccus in the fourth. Nemlinger (loc. cit.) reports the finding of the typhoid bacillus in seven out of eight cases of empyema and pleurisy with effusion.

B. THE LUNGS.

The lungs of a person dying at the height of the febrile attack, or at a more advanced stage of the disease, not uncommonly show signs of hypostatic solidification at the bases and behind.

True lobar pneumonia has been frequently observed. Horton Smith (The Typhoid bacillus and Typhoid Fever, London 1900) found it in 5% of his cases; the Munich Pathological Institute (Mun. Med. Woch., 1899, Ed. xxv., 16) in 8%, and Frankel (Deut. med., Woch., 1899, 15) in six out of five hundred typhoid cases. Typhoid pneumonia is nearly always due to the Fränkel-Weichselbaum diplococcus; occasionally to either the bacillus of Friedlander, or to a mixed infection of the diphtheroid pneumococci and streptococci and staphylococci. Frankel states that a mixture of the last two has been observed to produce a pneumonia in the course of the fever—confirmed by Foa and Hordone-Uffreduzzi (Rif. Med., 1887, No. 1).

Whilst the etiologic significance of Eberth's bacillus in the pneumonia of typhoid fever has been demonstrated by Brunneau (Thèse, Paris, 1893) and others, Frankel (Zeit. f. klin. Med., Bd. x.s. 439.), Flexner and Harris (Johns Hopkins Hosp. Rep., 1897) state that, in rare instances only, the lobar pneumonia has been produced by the invasion of already diseased areas of lung-substance by the typhoid bacillus.

Pulmonary abscesses, local or metastatic, are but rarely encountered at typhoid autopsies.

Gangrene—when found, is the result of putrid infection extending from the mouth, or elsewhere—the occurrence of spontaneous pulmonary gangrene being very unusual.

Haemorrhagic infection—of embolic origin from the heart, an inflamed area of the pulmonary artery—or a large systemic vein—is far from uncommon. They are peripherally situated, and usually undergo speedy absorption; but have been known to disintegrate and lead to empyema if not immediately fatal.

Tuberculous disease of the lungs has been observed during the course of enteric fever, and occurs either; (1) as part of a general miliary tuberculosis; (2) as an acute caseous lobar (rare) or lobular (common) pneumonia; (3) as an acute tuberculous peribronchitis; (4) as a rejuvenated sluggish atypical tuberculosis; (5) by exacerbation or extension of an old tuberculosis elsewhere; or (6) in mixed infection with other bacilli.
THE NERVOUS SYSTEM.

THE CEREBRAL MENINGES.

1. The Dura Mater may be found in a state of hyperaemia, adherent to the skull, and with its sinuses full of dark blood - with or without the presence of thrombi.

2. The Pia mater and Arachnoid frequently exhibit oedematosus swelling, or may be adherent, or distended with ventricular fluid. In the case examined by Schultz (Verhand. de Cong. f. Inner. med., Wiesfe Bd. v., s. 469, et seq.) the small cell infiltration of the meninges appeared to have extended into the cerebral substances.

The cerebral cortex, and basal ganglia, may, in rare instances, be found of a brownish colour, due to deposition or pigment in the ganglion cells, leading to obliteration of their outlines, and more or less generalisation.

The frequency of accumulation of round cells in the perivascular lymph spaces - leading to destruction of the adjacent nerve-cells - has attracted considerable attention, but without, however, any explanation being forthcoming.

Cerebral apoplexy, during that course of typhoid fever is of the greatest rarity; and cerebral abscess is either secondary to middle-ear disease, or part of a general pyaemic condition.

THE SPINAL CORD.

Hyperaemia of the cord and meninges has been noticed; and in the case, reported by Corschmann (Verhandl. d. Cong. f. inner. med., 1886), lying with spinal symptoms (Landry's paralysis) Eberth's bacilli were demonstrable; but not so in that of
Leudet (Gaz. méd. de Paris. 1861, 19), in which there were no spinal lesions discoverable at the autopsy. Curschmann (loc. cit.) Kumall (Zeit. f. klin. med., 1881, Bd. ii.), and Schiff (Deut. Arch. f. klin. med. Bd. 67, 1900), likewise report fatal cases, in which bacteriological examination of the cord gave negative results; but the last mentioned observer, at an autopsy of a case dying on the eighteenth day of the fever, found acute haemorrhagic transverse myelitis at the level of the fourth or fifth cervical vertebrae.

**THE PERIPHERAL NERVES**

Examination of the peripheral nerves has, so far, been attended by negative results.

**THE EYES**

Galezowski (L'Unio Méd., 1877, Bd. series, xxiii., 937 - 941) classifies the ocular lesions of typhoid fever thus;-

(1) Necrosis of the cornea.
(2) Thrombosis of the ophthalmic and orbital veins.
(3) Embolism of the arteria centralis retinae.
(4) Optic neuritis with atrophy of the disc.
(5) Defects of accommodation.

A more reliable and comprehensible classification, however, would be the following;-

(1) Affections of the conjunctiva and cornea.
(2) Uveal tract (iris, ciliary body, choroid, & vitreus).
(3) Crystalline lens.
(4) Optic nerve, retina, and retinal vessels.
(5) Orbit, and orbital circulation.
(6) Extra-, and intra-ocular muscles.
(7) Cavernous sinus, by extension of orbital disease.
(8) Sympathetic, with sloughing of the eyelids, in association with noma of the face.

Relative frequency of occurrence.

Diseases of the conjunctiva and cornea are most often encountered, the former being nearly always catarrhal, and phlyctenular - seldom ulcerative. Ulcerative keratitis, on the contrary, is seldom seen, and, by Hoelscher (Münch. med. Woch., 1891, xxxviii., 43, 62) twice only in two thousand autopsies.

Examination of the available literature points to the occurrence of the other ocular complications in the following order of frequency; (1) Retinal
haemorrhages; (2) diseases of the uveal tract and vitreus; (3) paralyses of the ocular muscles; (4) neuritis and neuro-retinitis; (5) orbital affections

THE EARS.

Otitis media occurs in about 21/2% of cases studied (Sorel - Soc. Méd. des. hop., 3d. Ser., vi., 1889, 224; and mengst - New York Med. Jour., June 6, 1896), the usual cause being hyogenic infection from the throat. It is seldom encountered before the second or fourth week of the fever, and then in debilitated patients whose mouth are filled with unexpectatorable mucus, or pus from existing ulcers. It is, therefore, only seen in grave and prolonged cases, in whom, also, it has been known to invade the mastoid antrum.

THE PAROTID GLAND.

Parotitis usually begins in the interlocular tissue; and, owing to the density of the capsule, may lead to gangrene; so that the entire gland may slough out, or produce thrombosis of the jugular or diploic veins - sometimes also septicaemia. The condition, is, consequently, not to be attended by a high mortality. According to Murchison (loc cit.) it occurs after the age of thirty - on the average about the age of thirty-one. Parotid suppuration is, fortunately, unusual; and the disease may be in one or both lobes. Parotid inflammation occurs usually from secondary pyogenic infection from the oral cavity; but, in the cases reported by Janowski (Centralbl. Bakter. und Parasit., 1895., 1895, xvi., 685) and Lahmann (Centralbl. klin. Med., Aug., 1891. 649) the presence of the typhoid bacillus itself cannot but be regarded as of etiologic significance.

THE THYROID GLAND.

The presence of the typhoid bacillus in the thyroid gland has been recorded by Cobzi (Revisi. Gen. Clin. Med., 1891, 10) Houl (Centralbl. f. Bakter and Parasit, xiv., 767). Jeansaline (Arch. Gen., 1893). Spirig (Corresp. Schw. Aert., Beb. 15. 1891), Dubray (Arch de Med. Exper. et d'anat, Path., Jan. 1. 1892, p.73) and Kummer and Tavel (Rev. de Chir., June 1891); whilst a case of mixed infection has been described by Spirig (loc. cit.)

The existence of goitre seems to predispose to thyroid suppuration during a typhoid attack, the infection travelling through the blood with ease.
GENERAL SYMPTOMATOLOGY.

PERIOD OF INCUBATION.

The average duration of the period of incubation, or latency, i.e. from the moment of infection to the appearance of the first indication of the disease, is extremely variable; but may be considered as from ten to fifteen days. It may, however, be as short as five days or as long as three weeks—a lengthening being much more common than a shortening. During this time there may be certain prodromes, or ephemeral pains, disinclination for exertion, anorexia, and headache, but the patient otherwise feels much as usual, or may even be entirely free from these discomforts.

CLINICAL COURSE.

For convenience of description, and in view of the peculiar temperature curve, the course of an attack of typhoid fever may be divided into three stages:

The stage of Invasion, or Development (Stadium incrementi) - during the first week.

The stage of Height of the Fever, or Fastigium (Acme) - during the second and third weeks.

The stage of Defervescence, or Decline (Stadium Decrementi) - during the fourth week (the third in mild cases.)

1. THE STAGE OF INVASION OR DEVELOPMENT.

The disease sets in very gradually, the patient experiencing chilliness and feverishness, headache, nausea and vomiting, and an acceleration of the prodromal symptoms. In rare cases, a rigor (convulsions in children) may usher in the attack, allowing of the calculation, with an approach to accuracy, of the duration of the disease. More usually, however, as noted, the invasion of the disease is insidious to a marked degree, during which the symptoms may be very anomalous, and of the nature of neuralgia, earache, sore-throat, intense headache, and pains in the chest, epistaxis—occasionally profuse in children—about this time may alone point to the beginning of the attack; but usually it is not long before the symptoms become intensified, so that the patient voluntarily seeks rest in bed and medical attention; and from now the commencement of the disease is dated in the majority of instances. There may be more or less diarrhoea about this time;
or, again, a slight constipation, which the patient endeavours to relieve by means of the usual laxatives, with the result that the bowels fail to take up again.

The stools at first consist of undigested material, but later become watery and of "pea-soup" appearance (considered characteristic of this disease), and peculiarly offensive odour. During all this time the patient may continue to go about, but in nearly every instance, by the end of the second week of the attack at the latest, he has to yield to the discomfort. The fever rises, day by day, in a terrace-like fashion, until the acme is reached at the fourth or fifth day, or later, according to the severity of the illness. There is now complete prostration, anorexia, intense thirst, and headache, the last in severe cases being of a most agonizing character. The skin feels hot and dry to the touch; and the patient suffers from disturbed sleep, or actual insomnia. The tongue will be noticed to be coated with a thick fur; and the breath to be offensive, more especially if the patient be constipated. Chilliness may alternate with flushings; and there may be some cough, and thoracic oppression. The pulse is full and quickened (from 90 to 110 per minute), and, in severe cases, usually dicrotic, and 120 per minute. The pupils are usually dilated; the face flushed; the countenance anxious; and the respirations of a peculiar sighing character.

The physical signs, during a typhoid attack, are not prominent. The abdomen, however, may be slightly tender, swollen, and tympanitic; with, perhaps, pain, and tenderness, in the right iliac fossa, and hardness, or gurgling, on palpation. The almost constant association of splenic enlargement and dry bronchitis point to the illness being that of typhoid fever. The urine is scanty, and darker than usual; of high specific gravity; deficient in chlorides; and loaded with both lithates and urates; in severe cases it may be albuminous, and infested with Eberth's bacilli.

11. THE STAGE OR FASTIGIUM.

This usually commences about the fourth or fifth day of the disease, and lasts, in typical cases, about two weeks. During the second week of the disease (i.e. the first of the fastigium), the general symptoms become intensified; the prostration more pronounced; and the emaciation more advanced. The tongue, if anything, is more coated, and drier;
the belly swollen and tender; and constipation, if existing, replaced by the characteristic diarrhoea ("pea-soup"), but sometimes not. The temperature remains elevated, and about 103°F. or 104°F. and of the continuous kind. The pulse is accelerated; the headache disappears, to, sometimes, become replaced by mild delirium, with nocturnal exacerbations. Cough, of a dry character, may be very troublesome; or definite bronchitic symptoms may be noticeable. The splenic enlargement is by this time easily appreciable.

From the eighth day or so (7th. to 12th), the pathognomic rosycolous eruption appears; and is observed to consist of rose-pink spots, two to four millimetres in diameter, circular or convex (but not pointed), flat, and of the size of lentils. The spots fade on pressure; and are never petechial as in typhus. They are to be found on the abdomen and sides of the chest - sometimes on the legs, back, loins, arms, and thighs - but they may be entirely absent in children and old persons. They fade, moreover, at death sometimes suddenly from the sides of the chest - and, during life, appear in successive crops, every day or two, so that, for correct estimation, they should each be marked with some distinctive sign ("o", "+", "x", and so forth) immediately upon their appearance. There are seldom more than a dozen to be found upon each patient; but, in exceptional cases, they may, however, be rather numerous.

Towards the end of the first week of this stage, and in severe cases, deafness may be noticeable; so also, symptoms of a grave character - especially those indicative of an intensification of the intestinal lesions. The abdomen may now be observed to have become greatly distended, painful and hard on palpation, and tympanitic on percussion. Severe pain may be complained of in that region - independent of palpation - whilst gurgling or crackling may be appreciable in the right iliac fossa. The diarrhoea shows no sign of abatement; and may occur six or more times during the course of the twenty-four hours. It will be found to consist of food-particles, and epithelial elements; or sloughs of Peyer's patches, or even blood. The stools are usually alkaline in reaction; and the spleen can usually be felt upon deep inspiration, or its marked enlargement demonstrated on percussion.

During the third week of the illness - second week of the fastigium - the general symptoms, just noted, become more persistent, or, in severe cases, intensified. The diarrhoea increases, and is observed to be even more offensive. The presence of necrosed material in the stools points to separation
of the Peyer's plaques as sloughs. The pulse exhibits variety, and may be anything from 110 to 130 per minute; and the temperature is apt to assume the remittent type. It is in this stage, moreover, that grave complications - haemorrhage, perforation, peritonitis, and pneumonia - are most frequently noticeable; and it lasts a longer or shorter period according to the intensity of the illness.

III. THE STAGE OF DEFFERENCESCENCE OR DECLINE.

In favourable cases, at about the twenty-first day of the disease, the fever begins to decline - terrace-like - and the general and local symptoms to abate; and the patient passes into convalescence at the end of the week, after the decline of the fever by lysis. The temperature may, however, take a sudden rise at any time, if indiscretion of diet be committed. The convalescence is sometimes, especially after a severe attack of the fever, very tardy, and often accompanied by great anaemia and debility; so that, for perhaps three months or more, the patient may not be able to do more than sit about; others, again, may be able to resume their employment after a few weeks' rest, the former condition being contributed to by the slow healing of the intestinal ulcers in the majority of instances.

In protracted case, moreover, the fourth week of the illness may be, as regards symptoms at least, hardly distinguishable from the third- or even more severe; so that the patient passes into the so-called "typhoid status, or state" - a condition of low muttering delirium, subsultus tendinum, carphology, anuria, or hyperuria, painful micturition, a dry, crown tongue - black, or cracked at the tip, sides, or dorsum, sordes on the lips and teeth. The patient is apathetic and anxious in countenance, and lies quite inert and helpless in bed; suffers greatly from bedsores; the heart's impulse is very feeble, or quite imperceptible, and death is, in the majority of cases, inevitable.

Apart, however, from the typhoid state, the the febrile stage is not infrequently prolonged into the fifth week, and, very occasionally, into the sixth, or seventh (Anders - Intern. Clinics. vol.i., April, 1895, p. 29).

About this time relapses occur in 3 to 10% of the cases - rarely, a second, third, or fourth time - with a repetition of the symptoms enumerated, but, usually, to a minor degree - though death from a relapse has been observed.

The above description is merely applicable to a typical case; and it must be understood that different epidemics vary so much in their clinical characteristics as to make it impossible to include all cases in any outline of the disease that might
be attempted.

**CLINICAL FEATURES IN DETAIL.**

**COMPLICATIONS AND SEQUELS.**

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**COURSE OF THE FEVER:**

The temperature curve in typhoid fever has now, very properly, come to be regarded as characteristic, and, therefore, for diagnostic and prognostic purposes, of the utmost importance. A mass of clinical evidence in this respect, and careful research into the vagaries of the temperature curve, has been collected by its pioneer Wunderlich (Arch. f. physiol. Heilk., Bd., iii 1861 - Die Thermom. am Krankenbettte, 2nd. Edm., Leipzig) as well as many of his pupils, and others; amongst whom the following merit special mention: Fielder (Arch. d. Heilk., Bd. iii.), Wachsmuth (Ibid., Bd. iv.), Thomas (Ibid., Bd. v., S. 331 u. 527), Thierfelder (Arch. f. physiol. Heilk., Bd. xiv.), Uhle (Ibid. Bd. xvii.), Grissinger (loc. cit.), Haumler (Deut. Arch. f. klin. Med. Bd. iii.), Immermann (Die Kaltwasser des Typhus Abdom., 1870). Ziemssen (numerous monographs); Liebermeister (Ziemssen's Handb. art. Typhoid Fever), Liebermeister and Hagentach (Die Beobachtungen und Veruche über die Anwendung des kalten Wassers bei fieber. Krankheiten, Basle 1868), and Jürgensen (Klin. Studien über die Behandlung des Abdomintypus mit kalten, Wasser, 1866; and Die leichteren Formen des Typhus, Volkmann's Sammlung klin, Vortr.).

During the incubatory period the disease exhibits nothing unusual in temperature; at least the temperature is seldom taken during it. But, if careful study of the case be made at this time, it will usually be discovered to exhibit daily variations in a large percentage, and at the same time to be associated with irregularity and instability of the pulse - especially towards evening. A marked variation in the pulse-temperature ratio at this period should lead one to suspect enterica - more especially if the person has been exposed to infection.

It is, however, in the stage of development of the fever (first week) that the temperature reaches its average height; and in a uniform step-ladder fashion. The ascent of the curve is usually completed in three or five days; or, less commonly, by the seventh. The evening exacerbation is a
degree or two higher than on the previous day; and so on, in a tide-like manner, until the acme is obtained - 103°, 104° or 105°F. The morning remissions, however, always lag behind the evening rise; and the temperature curve is accordingly of a remittent character, i.e., above the normal with a difference between the morning and evening registration in excess of the variation in health, of 1 1/2°F.

The acme of the fever being reached, a continuance of the height of the curve, with slight morning remissions, and an absence of the tide-like character of the initial period, is observed; but sometimes, however, during the third or fourth week of the illness (latter half of the fastigium), the morning remissions become decidedly greater; and this is a favourable sign. Again, in exceptional and severe cases, the thermometer may register a higher temperature than in the evening; if 104°F., or more, the outlook in such cases is serious indeed.

In mild cases, the evening temperature never exceeds 103°F; in those of average severity 104°F; with morning remissions to 102°F; hyperpyrexim exists when 105°F. is attained.

The maximum temperature occurs between 3 and 6 p.m., and the minimum between 4 and 8 a.m. The acme of the curve is maintained for a variable period depending upon the severity of the attack, and absence of complications; in mild cases, for one week; in average ones, ten to fourteen days; and, in the severest, from two to four weeks.

At the end of the fastigium, the stage of defervescence begins, and, as a general rule, the temperature curve indicates a decline of the fever by lysis; by which is meant a step-like descent, both morning and evening temperatures being a degree or two lower than during the preceding day. Exceptions to this rule, however, may be noted; (1) the morning remissions may, from the commencement of the stage of defervescence, reach the normal line, whilst the evening exacerbations become weaker and weaker until touching the normal - the temperature thus registered having a striking resemblance to that of the quotidian or tertian intermittent; (2) in rare instances, again, the morning temperature remits more and more each day, whilst the evening remains high for a few days.

It is between the stage of fastigium and that of defervescence that one may encounter the so-called "ambiguous period" of Wunderlich (Loc. cit.) which is characterised by a remarkable rise of temperature, twice daily, with striking irregularity. It is believed to be due to auto-intoxication, and lasts a few days, sometimes a week or more.
ABNORMAL TEMPERATURE CURVES.

A. In the Stage of Development.

The initial stage of typhoid fever seldom presents any variation from the course already described as typical; but, in severe cases, a commencement with a sudden rise of temperature, in association with an introductory rigor, is frequently observed; denoting an acute onset. Such causes are, moreover, apt to resemble typhus in the severity of their course.

B. In the Fastigium.

In the mildest forms of typhoid fever, this stage may be as good as absent, with defervescence commencing upon its first day. In other cases, again (not necessarily unfavourable), the fever assumes a decidedly remittent or intermittent character; and can only be distinguished from malaria by a careful examination of the blood. This form is most commonly observed in persons who have previously had malaria.

Sudden falls of temperature during this stage may be encountered; (1) without any apparent cause; (2) by a sudden fall of 10°F. or so, suggesting the onset of intestinal haemorrhage, the blood not necessarily appearing in the evacuations forthwith; (3) from peritonitis; (4) from abortion or premature labour; or (5) from collapse.

Hyperpyrexia is, on the other hand, indicative of either (1) the approach of defervescence - especially if manifesting irregularity; or (2) complications.

C. In the Stage of Defervescence

This stage is sometimes greatly prolonged - the morning temperature being normal, and the evening one slightly elevated - probably from mild auto-intoxication (as such cases nearly always give way to a laxative), or, in rare instances, to obscure inflammatory mischief, e.g., suppuration of the mesenteric glands, sluggish intestinal ulcers, anaemia, and exhaustion.

D. During the Convalescence.

Post-typhoid elevations of temperature (to 102°F., or 103°F.) are mostly observed in children and neurotic persons; and are termed "recrudescences"; must be distinguished from relapses; and are due to errors in diet, constipation, neurotic and emotional influences; as well as occasionally - local sequelae, as abscesses, and periostitis.

A marked rigor, and elevation of temperature, are not infrequently seen during the convalescence; and, having no apparent cause, may be disregarded so far as the prognosis is concerned.

In exceptional instances, the so-called "afebrile form of typhoid fever" may be encountered; which differs from the ordinary disease in the sole respect of having no characteristic, or definite,
cerebrospinal meningitis, and of acute tuberculosis, in the aged and very young persons, as well as in those of fair complexion.

Contrary to what might be expected, the eruption of typhoid fades immediately at death, so as to leave no trace whatever, of its antemortem existence, in the cadaver. During life, however, after fading, the previous location of the spots may be detected by a brownish discoloration, or minute vesicles; the same, nevertheless, being always of a very evanescent character.


DISTINCTION FROM TYPHUS EXANTHEM.

Typhus Exanthem. | Typhoid Roseola
---|---
1. Macules. | 1. Papules
2. Only slightly elevated, if at all. | 2. More elevated
3. Irregular borders diffuse and indistinct. | 3. Regular.
5. Do not entirely disappear on pressure. | 5. Disappear on pressure.
7. Dull red. | 7. Rose-pink
8. Appears early (3rd.- 5th. day) | 8. Appears late (about 8th. day).
9. Simultaneous appearance, and development in 1-2 days. | 9. In successive crops.
10. No recrudesences. | 10. Recrudesences common
11. Often on the face. | 11. Seldom, or never
12. Most marked on fore-arm and back of the hands, and least towards the trunk. | 12. On abdomen, and sides of the chest most.
11. MISCELLANEOUS ERUPTIONS-

These have no diagnostic value. Sudamina, or minute pearly vesicles, due to profuse sweatings, are common about the abdomen, axilla, and inner surface of the thighs. Urticaria, purpura, and purunkular exantheme, are rarely seen; so also scarletiniform and measles eruptions, during the second and third weeks of the fever. These are due, it is believed, to the exhibition of antipyretic drugs. Pelionata typhosa - a peculiar bluish subcutaneous eruption, the "taches blentres" of Troussseau - were one time held to be pathognomic of enterica, but are now known to be due to pediculi.

111. MILIARIA CHRYSTALLINA-

This occurs in enterica more often than in any other specific fever; but is always late in making its appearance (middle of the second to end of the third or fourth week); and, from its thin capsule, and clear contents, has been likened to tear-drops on the skin, the vesicles varying in size from that of a pin-head to a lentil. They are rounded, and appear upon the lower part of the abdomen, chest, and thorax - never on the face - and are very apt to be overlooked, unless sought for in a strong light. They never suppurate, and are speedily absorbed, or desquamated.

IV. HERPES.

Herpes is so seldom seen as to be of some diagnostic value when present, being then indicative of some other disease, as typhus, pneumonia, influenza, malaria, or cerebro-spinal meningitis. When encountered in typhoid fever, it is almost invariably in children; and upon the face, and either during the stage of development before the appearance of the characteristic roseola, or in the convalescence upon the trunk or extremities.

V. BOILS, ABScesses, PHLEGMONS, AND Erysipelas.

These are not so very infrequently encountered; and are due to infection with pyogenic cocci; and occurring late in the disease, so as seriously to retard convalescence, and, in debilitated persons, to sometimes threaten life. Cutaneous abscesses may be very numerous, and are usually due to bedsores. Boils are most apt to occur in those subject to the cold-bath treatment - generally about the chest, abdomen, and gluteal region - or in cases of general pyaemic metastasis.

VI. BED-sores;

In well-nursed patients these rarely occur, or, if they do, are quickly arrested. They are to be found on the parts subjected to pressure; and due to either the and due to either the latter (usually), or to severe pyaemic infection - in the latter event, it may be, as early as the eighth day, and then materially adding to the duration of the febrile stage, and
thereafter considerably retarding convalescence.

Some authors describe three forms of bed-sores; (1) Those due to simple pressure; (2) a crop of bed-sores, due to bad nursing and cardiac weakness, simultaneous with boils and eczematous eruptions in the gluteal and sacral regions, leading to numerous ulcers; and (3) the so-called subcutaneous bed-sores, occurring quite independent of pressure-points, about the lower part of the sacrum and coccyx, and below the anal fold. This form is only seen in the severest class of cases, and points to grave trophic disturbances; arises independent of carelessness on the part of the nurse, and is apt to be overlooked, as the initial infiltration is concealed at first by the apparently healthy skin. It usually causes an extensive destruction of skin (gangrene); and has been known to follow careless poulticing, application of ice-bags, and irritant remedies.

N o m a.

Noma has been said to have been encountered by the older writers; their experiences, however have not been substantiated by modern authors.

VII. O E D E M A.

Oedema of the skin, when observed, is found to be due to either anaemia or cachexia - occasionally nephritis. Thrombosis of the femoral vein, however, has been known to be productive of oedema of the leg.

VIII. O D O U R A peculiar 'musty' odour - likened by Behier to that of the blood - is said to be exhaled from the skin in some cases of typhoid.

IX. T H E H A I R, A N D T H E N A I L S.

(a) The Hair.

The hair of the scalp (sometimes of the beard) - rarely elsewhere) very often falls out during the typhoid attack, and is apt to produce alopecia. It is observed to commence during the stage of decline, and to last far into the convalescence; a new growth, of a stronger, thicker, lusterless, and curly, character, replacing that shed.

(b.) The Nails.

The nails - usually of the fingers, rarely the toes - sometimes become brittle, exhibiting transverse striations or gutterings; and indicative of great bodily depression, and lowering of vitality; it is rare, however, to find them cast off (Vogel- Deut. Arch. f. klin. Med., Bd. vii., S. 333, et sed.)

T H E D I G E S T I V E S Y S T E M.


In severe cases, these parts may show great disturbance of function and equilibrium; the first effect of the fever upon them being evidenced as dryness
especially if the tongue and markings of the teeth on the latter. The upper lip becomes retracted, leaving the teeth exposed; and the buccal area, and mouth generally, becomes coated with a thick fur. The lips rapidly become fissured and eczematous, and the gums spongy and bleeding. The tongue, besides bearing the imprints of the teeth, assumes a characteristic appearance, viz., dull red, and with a strip of fur, or thick sordes, on its edges, sides, and tip. In the first stage of the disease, however, the dryness of the tongue may only be complained of at night; and the characteristic described disappears only towards the end of the third week, to leave the member more red and pointed than before. The dryer the tongue at first, the more the likelihood of having the typhoid status to deal with later on; and it is due to the evaporating effect of the pyrexia, the arrest of salivation, and the patient's lying with his mouth open, as well as his inability to keep it moistened in the usual way.

During typhoid convalescence McCrae (Johns Hopkins Hosp. Bull., vol. ix.) states that the tongue may present the rare condition of actual inflammation. It is particularly noteworthy that in typhoid fever the member hardly ever presents any morbid alteration.

Stomatitis, usually of an ulcerative kind, has been known to result from neglect of the hygiene of the mouth in typhoid cases.

Thrush, affecting the mouth, and sometimes extending as far down as the oesophagus, has been encountered as a fairly common complication.

Tonsils -

A special form of typhoid has been described - "tonsillo-typhoid", or "pharyngo-typhoid" - characterised by the presence of peculiar patchy elevations upon the tonsils, of grayish-white appearance, and exhibiting a marked tendency to subsequent ulceration. They are, in all probability, due to the action of the baccilli in such an unusual situation; for they have been frequently discovered in the floor of the ulcerated areas.

Pharynx -

The action of the febrile state does not usually extend beyond producing a simple swelling and dryness of the pharynx; but, in severe cases, the deposition of viscid ropy mucus may seriously interfere with respiration. Typhoid angina was well known to the earlier writers, and is now again coming into prominence in the literature; which latter, however, gives no bacteriologic, explanation, of the phenomenon.

Oulmond (Rev. de Méd. et Chir. de Paris, July, 1855), and others, describe a diphtheritic affection of the pharynx, occurring usually at the beginning
of the third week, extending into the middle ear by way of the Eustachian tube.

Actual sore-throat may be noticed at the onset of typhoid fever; sometimes even in association with a scarletiniform rash.

Parotitis

Inflammatory affection of the parotid gland occurs in about 1%, or less, of the typhoid cases; and is, therefore, not of common occurrence; resulting from want of cleanliness of the mouth, or metastatic infection. It generally occurs at the height of the fever - rarely during the convalescence; and presents nothing unusual in course, beyond a remarkably acute pain. Suppuration of small areas, or the entire gland, may result; but an actual gangrenous destruction has been occasionally reported.

Virchow (Charité-Annalen, 1858) contended that an extension of infection from the buccal cavity accounts for the majority of cases; it may, however, be found in association with ulcerative stomatitis; or again, as part of a general glandular enlargement from the effect of the toxine; still further, perhaps, to the action of the bacilli in such an uncom¬ com situation - confirmed by Janowski (Centralbl.f. Bakter., Bd. xviii) being able to obtain a pure culture of Eberth’s bacillus from the suppurating gland. Anton and Flüggerer (Münch. med. Woch., 1888, No. 19) found the bacillus in the pus in association with pyogenic bacteria. The metastatic origin of the parotitis has already been referred to, and probably accounts for more cases than usually supposed.

Parotitis occurring in the course of typhoid fever is betrayed by pain, redness (later fluctuation) and pyrexia; and is usually unilateral (rarely bilateral); and one of the most serious complications of the disease; being frequently fatal - especially when inducing thrombosis of the jugular vein and cerebral blood-sinuses. The supplicative process may, on the other hand, extend to the cranial bones and muscles, between the layers of the cervical fascia, and into the mediastina (with pressure effects); or, again, produce pyaemia.

Oesophagus

So far as distinctive symptoms are concerned, the oesophagus seems to be unaffected by the fever; small ulcers, or erosions, have, however, been noticed at autopsies. Mitchell (Johns Hopkins Hosp. Rep. vol. vii) refers to the marked dysphagia, as being a marked ante-mortem feature in such cases. Summers (Phila. Med. Jour., Oct. 23. 1899) reports the occurrence of stricture of the gullet during the convalescence.

Stomach

The stomach presents no characteristic symp¬
toms; but neurotic persons may complain sometimes
of a sense of oppression (not amounting to pain—which would negative typhoid fever) in the epigastrium at the onset of the disease.

Nausea and vomiting—whilst occurring at any stage of the disease, are most common at the beginning—more especially in children and neurotic persons—and soon cease to be complained of. When noticed as late symptoms, they are nearly always due to typhoid ulceration or peritonitis. Nausea, in the earlier stage of the disease is usually traceable to dietetic errors, or irritant medicines; but, when severe, and intractable, at the acme, is indicative of such complications as cerebral affections, hemorrhage, peritonitis, and so forth, Indiscretions of diet frequently produce the condition during the convalescence. It should be noted, however, that vomiting may be due to unknown and inevitable causes; quite unaccounted for at the necropsy, and usually in cases protracted by other complications.

Acute gastritis is present but rarely. Anorexia has been referred to elsewhere; but it may be further noted that the appetite is entirely lost, and a great distaste for food developed, during the febrile stage (as in other fevers); and that, during the convalescence, the appetite returns, almost without exception, and is sometimes markedly voracious.

Dilatation of the Stomach.

Legendre (Dilatation de l’estomac et fièvre typhoïde - Thèse, Paris, 1886) has endeavoured to prove that the typhoid fever attack is directly associated with gastric dilatation; and the the former occurs with greater readiness in those suffering from the latter. This view, however, has not met with much acceptance from lack of confirmatory evidence.

Liver and Biliary System—

The Liver—

During the height of the typhoid attack, no doubt, the liver may be slightly swollen, and tender, on palpation; but, even in the severest cases, this is not exceeded, and no characteristic symptoms of liver mischief induced.

Jaundice.

Contrary to what is usual in other fevers, jaundice is but rarely encountered in typhoid; and generally does not come on until the middle of, or late, in the disease. In view, therefore, of its
great rarity — accounted for by the brunt of the attack falling on the part of the digestive tract below the stomach — its occurrence would (other things being equal) negative typhoid fever (Liebermeister - loc. cit.; and Da Costa - Trans. Amer. Assoc. Phys., vol. xiv.)

Da Costa (Johns Hopkins Hosp. Rep., vol. viii), from a study of 52 recorded cases, attributes jaundice to the following causes; (1) Catarrh; (2) pylephlebitis; (3) cholecystitis; (4) abscess; (5) acute yellow atrophy; (6) toxicity; and (7) uncertain influences.

Osler (Johns Hopkins Hosp. Rep. vol. xiii.) on the other hand, classifies cases of typhoid icterus in four divisions; (1) Catarrh; (2) toxia; (3) cases in association with abscess; and (4) those in association with gall-stones and cholecystitis. This classification, being the usually accepted, merits further consideration.

(1) **Catarrhal Jaundice.**

Occurring in the course of an ordinary mild attack of typhoid fever, icterus is usually of this nature — both gall-bladder, and bile teeming with Eberth’s bacilli, as Blackstein (Johns Hopkins Hosp. Bull., 1891, vol. ii.), Chiari (Pra. med. Woch., 1893, No. 22), Gilbert and Girode (Sem. méd., 1890 No. 58; and Compt. rend. de la Soc. biol., 1891, No. ii.), Birch-Hirschfield (Path. Anat. Bd. ii. 4Aufl. S. 694) and many others, have pointed out.

(2) **Toxica Jaundice.**

This form, according to Da Costa (loc. cit.) occurs, as a rule, as a late symptom, and in grave cases, and resembles the jaundice seen in other infectious diseases, and other altered blood states, as pyaemia. The stools are but little altered by it; and the condition of the liver throws but little light upon the phenomenon; yet, when the organ has been carefully examined, it has been found to show degeneration of its cells, of a kind similar to that found in acute yellow atrophy. It is always a very rare condition; and appears at the height of the illness; and is sometimes associated with pain and swelling of the liver, later being followed by progressive diminution in size of that organ. The onset of the jaundice is heralded by haemorrhage from various viscera — including the bladder — albuminuria, and failure of the heart’s action — the patient dying in a comatose condition.
Jaundice with Hepatic Abscess.

This form of icterus is generally believed to be due, not to the local action of the typhoid bacilli, but to one or other of three factors; (1) As part of a general complicating septicemia or pyaemia, (Chvostek - Allg. Wien. med. Zeit., 1866, No. 37); (2) septic pylethrombosis, in conjunction with intestinal (especially caecal) abscess (Romberg - Berlin. klin. Woch., 1890, No. 9; Tüngel - klin. Mittheil., Hamburg, 1862 - 63; Asch - Berl. klin. Woch., 1862, No. 51; Buckling - Inaug. Dissert., Berlin, 1866); and (3) from ulceration of the gall-bladder and large biliary passages (Klebs - Handb. der path. Anat., 1868, p. 480).

This latter condition of inflammation of the gall-bladder and large biliary passages, has been described as being of the nature of a diphtheritic affection - a pseudomembranous ulceration - terminating in hepatic abscess, peritonitis, and so forth (Ryska - Münch. med. Woch., Bd. 56, No. 23; Da Costa - loc. cit.; Camac - Johns Hopkins Hosp. Rep., vol. viii; Osler - loc. cit.; and Mason; Trans. Assoc. Amer. Phys., vol. xii.).

In cases of cholecystitis, and cholangitis, pure culture of the typhoid bacillus have been obtained - thereby demonstrating its etiologic significance. Gall-stones, however, are usually absent in these cases - though present in a few; and the obstruction is, therefore, probably due to some other cause, as the accumulation of mucus, in which, moreover, the bacilli can thrive, and sometimes produce perforation of the viscus.

A patient suffering from complicating cholecystitis will complain of pain and tenderness over the site of the gall-bladder; in which area also a distinct tumour can be felt, sometimes even extending as far down as the umbilicus.

Jaundice with Gall-Stones.

Cholecystitis has been discussed above; but it may be further noted that the bacilli are frequently found to be clumped in the bile, and in such a way as to form the nuclei of gall-stones; the latter also having been experimentally produced by inoculation of the viscus with Eberth's organism in the laboratory (Richardson - Jour. Boston Soc. Med. Sci., vol. z; and Gilbert and Fournier - Compt. redn. de la Soc. Biol., Oct. 30, 1897).

According to Hunner (Johns Hopkins Hosp. Bull, vol. x.) Eberth's bacilli can preserve their vitality in the gall-bladder, and produce suppulsive cholecystitis, there, for as long as eighteen years after a typhoid attack; as substantiated by the obtaining of the bacillus from the pus in pure
culture.

Condition of the Bile. In direct contrdistinction to what is usual in other fevers, the bile, during a typhoid illness, is thinner, lighter, and limpid (very rarely has the viscid and dark secretion of typhus been noticed,) and its specific gravity varies from 1010 to 1016, instead of from 1026 to 1030 of health. This lowering of its specific gravity, so far as we know, produces no alteration in the condition of the urine; and of the stools, the only abnormality traceable to it being the occasional bleaching of the tissues. Tissier (These, Paris, 1890), however, claims an intimate relationship between the presence of the bile in the urine of typhoid patients, and the alteration in the bile described.

The Intestines.

Symptoms referable to the intestinal tract are of the utmost interest and importance from their direct connection with the specific lesions of typhoid fever, and the correspondence of the stage of the disease to the development of such lesions. It should be remembered, however, that this relationship is far from being constant, as observed in the case of patients who may, either not be confined to bed at all by the disease, and yet suddenly die from haemorrhage, or other intestinal accident; or who, on the other hand, may have severe intestinal symptoms before the development of definite etiologic lesions.

THE STOOLS.

It is a noteworthy fact that, at the onset of the malady, constipation is usual; and that this, again, may persist throughout the entire illness, although it is, in the majority of instances, replaced by the characteristic diarrhoea; which latter Osler (Phila. Med. Jour. Oct. 15, 1900) has observed as an initial feature in 322 out of 829 cases.

During the second week of enterica, the stools average from two to four daily; only in severe illnesses (from catarrh or ulceration of the large intestine - the colon in particular) exceeding that number in the course of the 24 hours. Some cases, moreover, take on a dysenteric character, with involuntary discharge of faeces, from the ulceration of the colon having become intensified by diphtheritic inflammation of the neighbouring mucosa.

The stools themselves present a characteristic yellow appearance, and liquidity, and are, very appropriately likened to "pea-soup". Instead, however, of being fluid, they may have the consistence of jelly. They are alkaline in reaction; possess a most offensive odour; and, on standing, are observed to separate into; (1) an upper liquid cloudy layer,
and (2) a lower, thick, yellow, sedimentary layer, in which can be seen food particles, and yellowish gray fragments \( \frac{1}{2} \) to 1 inch in length, consisting of crusts of necrosed Peyer's plaques. Microscopical examination of the sediments shows it to be made up of undigested remnants of food, epithelial debris, blood corpuscles, innumerable bacteria (the presence of the typhoid bacilli has been referred to elsewhere), and crystals of triple phosphates in abundance; the latter being erroneously supposed by the older writers (Schönlein - 1834 - &c.) to be of specific importance. They are undoubtedly to be found in cases of typhoid fever more often, and more constantly, than in any other disease, and may accordingly be given a certain amount of diagnostic significance.

**METEORISM.**

Cases seen early, and treated properly, seldom suffer from this distressing complication, which can usually be interpreted as indicative of severity of seizure; and as directly resulting from paralysis of the muscular coat of the intestine from the sheer debilitation produced by the intensity of the general infection - not necessarily to the gravity of the intestinal lesion. Some cases, indeed, of this affection are attended by but little diarrhea, but on the other hand a constipation, an invariable associate; but rather, when present, a direct sequel. It is the large intestine, as a rule, to which it is specially located - more especially the transverse colon. Exceptionally, however, the small intestine may be affected (pushing up the transverse colon to the back of the abdominal cavity) - preferably the jejunum, and upper part of the ileum, i.e., those parts of the small gut least often the seat of medullary infiltration.

Gaseous distention of the bowel may likewise result from peritonitis, intestinal haemorrhage, incarceration of the intestine, volvulus, intussusception, and peritphilitis.

The interference with respiration produced by severe meteorism is frequently a grave and distressing feature of the illness; but usually a moderate amount only of pressure and abdominal discomfort are experienced; in addition to which there may be the tenderness on palpation, over the ulcerated areas in general, and in the right iliac fossa in particular. About two-fifths of the patients are quite free from pain and tenderness; and one-fifth complain of tenderness only. Pain, not due to specific intestinal lesions, is present in 14%; and, consequent upon haemorrhage or perforation, in 5% (especially from the latter, in which the suffering is severe, sudden, and paroxysmal; and in about two-fifths of the cases from no apparent cause (Mc Crae -
loc. cit."

"Gurgouillement" - gurgling, or splashing - has been observed, especially by the older writers, with great frequency during the course of a typhoid attack; and may be appreciated by palpating over the coecus. It is by no means so important a feature of the disease as formerly supposed, and is absent altogether when the coecum is free from anatomic alteration.

**INTESTINAL HEMORRHAGE.**

Care must be taken not to confuse with this most dreaded complication of typhoid fever the presence of blood in the stools from extraneous causes, such as haemorrhage and rectal fissures, in which the blood, moreover would be bright red, mixed with mucus, and lying in, or upon the faeces - not intimately blended with them.

Intestinal haemorrhage is one of the most important events in a typhoid seizure; and occurs, on the average, in 4 to 74 of the cases - its frequency varying with the character of the epidemic. It is most often encountered towards the end of the second or third week; and is due to opening of the blood-vessels by a process of ulceration or necrosis, or, again, to escape of blood from the hyperaemic edges of the ulcers. If observed early in the illness it is then either consequent upon an haemorrhagic diathesis, or due to excessive congestion of the lymphoid follicles.

The amount of blood lost varies greatly, being sometimes barely appreciable, or in other instances, perhaps, as much as two pints or more. If slight, the stools are but slightly reddened, or darkened; but, if large, and slowly extravasated, the blood is not necessarily expelled at once, may accumulate, and be transformed into a black coagulated mass. If, on the other hand, the bleeding be profuse, it may excite pain and peristalsis, and be rapidly expelled from the intestinal tract in an almost unaltered condition. It should be remembered, moreover, that haemorrhage may have taken place high up the bowels (and slowly), and yet the blood not be discharged for several days afterwards. This is specially apt to be the case when of the nature of ooizings from the infiltrated Peyer's patches - the blood accumulating within the lumen of the bowel as viscid, black, tarry, masses; appreciable, perhaps, on percussion and palpation.

The diminished frequency of haemorrhage during a relapse of typhoid fever (1 1/4%) is noteworthy; and is always to be regarded, when occurring as unfavorable then as at other times.

Recovery, even after a profuse, and may be
protracted bleeding, is possible; but death occurs in about 40% of all cases, from the intense anaemia, and exhaustion, produced by repeated losses. Should, however, the first haemorrhage not prove fatal (the usual phenomenon), the patient becomes remarkably altered in appearance - his skin assumes a waxy hue, and is cold and livid; his body becomes greatly emaciated; his pulse quick, and soft; and his temperature subnormal, so that the curves of the pulse and temperature cross one another, at the same time as symptoms of a syncopal character are observed. Even a slight haemorrhage will induce a rapid, and marked fall of temperature, so sensitive is the latter to the former; not so, however, the pulse, a fall of which simultaneously with the temperature (in the absence of course, of haemorrhage, and so forth) admits of a favorable interpretation.

Expulsion of the extravasated blood in clots must always be regarded as of unfavorable prognosis, and as indicative of the rupture of a large vessel (located to the lower part of the bowel - usually the colon), and of a large quantity lost.

Trousseau (Clin. Med., 2nd. Edn., vol. i., p 238), and Graves (Clinical Lectures, 1848, vol.i.), however, regard lightly the occurrences of intestinal haemorrhage, and as by means of unfavorable omen. A slight loss in the case of a plethoric person may, doubtless, relieve the urgent symptoms of the febrile attack, reduce the temperature, diminish the splenic enlargement, and lead to a speedy convalescence.

PERFORATION.

Perforation of the intestine, by almost invariably producing diffuse, and fatal, peritonitis, is the acident of accidents to be dreaded, and it, moreover, bears no fixed relationship to the severity of the illness, as it occurs frequently in cases unattended by severe diarrhoea.

As a rule there is only one opening, but as many as twenty-five have been recorded (Hoffmann - loc. cit. ) Occasionally two or three may be observed lying close together, very rarely two holes separated by a considerable portion of the intestine. Fitz (Trans. Amer. Assoc. Phys., 1891, vi. p. 200) gives the following observations of the number of perforations in 167 cases, the two last cases being reported by Lebert (Ueber die Typhus- u. d. Typh. Epid. d. Jahr. 1857), and Hoffmann (Untersch. u.d. path. anat. Veränd. d. Organ. beim. abdominal typhh., 1869);

<table>
<thead>
<tr>
<th>Number of Cases</th>
<th>Number of Perforations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Perforation in 19 cases</td>
</tr>
<tr>
<td>5</td>
<td>&quot; 3 &quot;</td>
</tr>
<tr>
<td>4</td>
<td>&quot; 1 Case</td>
</tr>
<tr>
<td>Several</td>
<td>&quot; 4 Cases</td>
</tr>
<tr>
<td>25 to 30</td>
<td>&quot; 2 &quot;</td>
</tr>
</tbody>
</table>
Perforation of the intestine occurs at the same time as the separation of the sloughs (prior to that being of great rarity), at the end of the second or of the third week; and in cases, obviously, of deep ulceration down to the peritoneum - that delicate structure giving way from slight mechanical influences such as gasæous and localised distension of the bowel, pressure of the intestinal contents, vomiting, alteration of the patient's posture, straining at stool or micturition, and from dietetic errors. Ulceration right through the peritoneal coat - with perforation at the same time as separation of the sloughs - is seldom encountered; for, as a rule, the ulcerative process stops short of complete perforation - the patient's life being saved by the protective adhesions formed to neighbouring parts. Unfortunately, however, perforation has been known to occur late in the disease, up to the fortieth day or beyond, from either (1) a breaking out of the healed ulcers - yielding of the cicatrices; (2) a return of the ulcerative process; or (3) sluggishness of the ulcers - the latter, according to Griessinger (loc. cit.) being by far the most common cause of late perforation.

Frequency of Perforation.


Predisposing causes.

Age is said by some to have no influence upon the occurrence of perforation; others, again, attach great importance to it, and state that the accident is most common between the ages of 18 to 40, and that it is rare in children from the lesser intensity of the fever in their case. Fitz (loc. cit.) gives the following table of the ages at which perforation occurs:

<table>
<thead>
<tr>
<th>Age</th>
<th>Cases</th>
<th>per. cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 10 years</td>
<td>7</td>
<td>3.6</td>
</tr>
<tr>
<td>10 to 20 years</td>
<td>46</td>
<td>23.8</td>
</tr>
<tr>
<td>20 to 30 years</td>
<td>77</td>
<td>39.8</td>
</tr>
<tr>
<td>30 to 40 years</td>
<td>45</td>
<td>23.3</td>
</tr>
<tr>
<td>40 to 50 years</td>
<td>14</td>
<td>7.2</td>
</tr>
<tr>
<td>50 to 60 years</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>60 to 70 years</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>192</strong></td>
</tr>
</tbody>
</table>
Sex. Men are more apt to suffer from perforation of the bowel than women; but the observation has no intrinsic value; the former being more often subject to predisposing intestinal troubles than the latter, and usually later in presenting themselves for treatment.

Social Position—Those living amidst unhealthy surroundings, and hardships, are more apt to suffer from perforation.

Date of Occurrence—This varies a good deal, but the following table of Fitz (loc. cit.) gives a fair idea as to what may be expected, and corresponds pretty closely with the results obtained by other writers:

<table>
<thead>
<tr>
<th>Week</th>
<th>Cases</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>32</td>
<td>16.5</td>
</tr>
<tr>
<td>Third</td>
<td>48</td>
<td>24.8</td>
</tr>
<tr>
<td>Fourth</td>
<td>42</td>
<td>31.7</td>
</tr>
<tr>
<td>Fifth</td>
<td>27</td>
<td>14.0</td>
</tr>
<tr>
<td>Sixth</td>
<td>21</td>
<td>13.4</td>
</tr>
<tr>
<td>Seventh</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Eighth</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ninth</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tenth</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Eleventh</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Twelfth</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sixteenth</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>193</td>
<td></td>
</tr>
</tbody>
</table>

Character of the Perforation.

The perforation, if resulting from ulceration of a solitary gland, will be small and round; if at the site of a Peyer's patch, larger and rounded, sometimes, involving half of the circumference of the bowel—the opening being either clean cut, or shreddy, with the tissues at the edge of the opening, perhaps, greatly attenuated.

Duration of Life after Perforation.

Here again we have to resort to the statistics of Fitz (loc. cit.), for information, who gives the following observations in 134 cases:

Died on the first day .............. 37.3 percent
" " second " .............. 39.5 "
" in " first week .......... 83.4 "
" " second " .............. 9 cases
" " third " .............. 4 "
" " thirty days .............. 1 case
" " thirty-eight days .............. 1 "
Seat of the Perforation.

Perforation most usually occurs in the parts of the intestine specifically affected (viz. Peyer's patches, and solitary glands) and in the lower part of the ileum near to the caecum. It has, however, been known to occur in the upper part of the ileus (upper third), and even in the jejunum (Hoffmann - loc. cit.). Perforation of the caecum itself, and of the appendix vermiformis, are but rarely encountered; so also perforation in other parts of the colon, and in the rectum.

Fitz's analysis (loc. cit.) of 4080 cases of typhoid fever shows the accident to have occurred in the large intestine in 12.9 %, and in the vermiform appendix in 2.5 % in the jejunum in only 1.29 %.

The same writer gives the following table of the seat of the perforation observed by him in 167 cases;

<table>
<thead>
<tr>
<th>Seat</th>
<th>Cases</th>
<th>Per Cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ileum</td>
<td>136</td>
<td>81.4</td>
</tr>
<tr>
<td>Large intestine</td>
<td>20</td>
<td>12.9</td>
</tr>
<tr>
<td>Vermiform appendix</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Meckel's diverticulum</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Jejunum</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Hawkins (Lancet - 1893, ii., 245), in 72 cases of perforation, found;

<table>
<thead>
<tr>
<th>Seat</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>in the ileum</td>
<td>61</td>
</tr>
<tr>
<td>&quot; caecum</td>
<td>3</td>
</tr>
<tr>
<td>&quot; appendix</td>
<td>3</td>
</tr>
<tr>
<td>&quot; colon</td>
<td>5</td>
</tr>
</tbody>
</table>

Adding to these five other five from various sources, there were two in the ascending, one in the transverse, and seven in the descending colon, of which latter five were in the sigmoid flexure.

We may conclude therefore, that if no perforation be found in the ileum, caecum, or appendix, the next most likely spot would be the sigmoid flexure. A curious case of perforation occurring in the looped intestine in a hernial sac has been reported by Haegler (Corresp. f. Schweiz. Aerzt., 1896, No. 17).

Symptoms of perforation.

The accident is first suspected from the sudden onset of acute, stabbing, or lacerating pain in the abdomen; speedily followed by symptoms of collapse of the circulation (evidenced by the pinched appearance of the features, hollow cheeks, vomiting, a small frequent pulse, and fall of temperature), and the development of diffuse peritonitis. The abdominal muscles become rigid, as well as tender on pressure; the abdominal cavity tympanitic, and the hepatic dulness, perhaps, obliterated.

Sometimes, however, perforation may be preceded
by indefinite symptoms, as colic, noises of flatus in the intestines, increased abdominal pressure, or tension, diarrhoea, and some amount of haemorrhage.

Though referred occasionally to the right hypogestrium, the pain usually occupies no definite situation, and is accompanied or preceded by intense retching, and vomiting of either faecal matter, bile or blood.

The abdomen becomes more and more distended, so as sometimes to seriously interfere with diaphragmatic respiration. Constipation is marked from the outset of the perforation, and remains unrelieved; flatus fails to be passed; and the symptoms gradually come to resemble those of intussusception — for which it is frequently mistaken, and which sometimes actually occurs when the peritonitis is developed in the neighbourhood of the ileo-caecal valve and lower part of the ileum, in such a way as to occlude the lumen of the bowel.

The appearance of the patient becomes strikingly altered; the features become pinched, the nose pointed (Hippocratic facies), the limbs cold, and the skin covered with a clammy, cold, perspiration. The pulse at the same time becomes irregular, quick, small, and thready, so as to be almost imperceptible.

With the occurrence of diffuse peritonitis, the temperature rises, but only slightly; but with the approach of death, however, it either rises to a marked degree — this with an initial rigor, or falls considerably.

In severe cases of perforation (large openings) the intestinal contents disseminate themselves throughout the abdominal cavity, and the train of symptoms just described occur with great rapidity, and the patient may be found to be in a state of collapse in a few hours. Should, however, the latter not occur, there may be some difficulty in diagnosing the condition; as it is noteworthy, that such patients retain consciousness to the very end, which usually occurs at the end of the second or third day, or the fourth at the outside, in the vast majority of instances.

Should, however, the peritonitis develop less rapidly, the patient may rally for a time; his temperature rise, and pulse regain its equilibrium, especially if the inflammation be localised — which it seldom is.

Should the patient live for a week or more (Vide Fitz's table of the duration of life after perforation,) the symptoms at the same time alternately subsiding and increasing, it would indicate the existence of small sieve-like openings close
together, allowing of the gradual escape only of the smallest quantities of the intestinal contents, which, by the formation of local inflammatory adhesions, are kept localised.

With special reference to the result of intestinal perforation, it may be further remarked that, in a few instances, a localised abscess, as in cases of appendicitis, may be formed; but, unfortunately, in the majority, no such enclosure takes place, suppurative peritonitis rapidly following the perforation. In view of the increased infectivity of the intestinal contents, and the contained typhoid and other bacteria, this is just what one would expect. The more numerous the perforations, the more likelihood of the peritonitis becoming general. Curiously enough, it is but seldom that the typhoid bacillus is to be found in the peritoneum after perforation, and this probably from its being speedily destroyed there by the overwhelming numbers of other micro-organisms (Finney - Annals of Surg., 1897. xxv., 233).

**Early Diagnosis of Perforation.**

The presence or absence of leucocytosis is of valuable diagnostic significance, and has had its importance emphasised by numerous authors. According to Thayer (Johns Hopkins Hosp. Rep., vol. iii) the occurrence of perforation invariably leads to marked leucocytosis. Sometimes, however, the increase in the number of the leucocytes is but slight, and requiring repeated examinations for its appreciation. It should, moreover, be noted that the white corpuscles greatly increase in number during the fever without the presence of any etiologic complication, as pointed out by Cabot (Clinical Examination of the Blood, 1897), who states that it occasionally happens, in very exhausted persons, that complications fail to produce any leucocytosis, the patient (e.g., in some deadly cases of pneumonia, and of purulent peritonitis) being unable to react against the infection. These cases are, however, quite exceptional; but Cabot, nevertheless, in four cases of ordinary typhoid fever, found the count as high as 17,700. This experience is usually regarded as an isolated one, as marked leucocytosis is usually to be found in perforation, or other severe complication of typhoid fever, as instanced by the following table from Cabot's work:-

**PERFORATION...** Case 1. (a) Five days before perforation - 8,300.

(b) At time of perforation, 24,000.

Case II - At time of perforation, 18,500.
PHLEBITIS... Case 1.-(a) Two days before onset 8.400.
(b) At time of onset 2.500
(c) One week later, 10.100

Case 11.- (a) One week before onset... 4.800
(b) At time of onset 16.200

OTITIS MEDIA. Case 1.- (a) At entrance, 5.300.
(b) Mastoid abscess, 16.400

Case 11.- (a) At entrance, 8.400
(b) Two weeks later, after opening the membrana tympani (sero-purulent discharge) 11.300

Case 111.- (a) At entrance, 7.320
(b) Otitis, 14.000.

A blood-count should, therefore, be made in all cases of doubtful perforation, in order to allow of early operation.

As particularly emphasised by M. Crae (Johns Hopkins Hosp. Bull., vol. ix.) and by Cobb (Boston Med. and Surg. Jour., June 28, 1900) the onset of sudden acute pain is to be regarded as the most important of the early symptoms for diagnostic purposes. It may be either constant, or come in paroxysms; and is usually observed long before the other characteristic symptoms of the condition, although a certain amount of associated tenderness, localised generally to the hypogastrium, is common. Again, the characteristic pain, pointing to the occurrence of perforation, is nearly always of sudden onset, it may at times be gradual; and there may even be perforation without it, and lacking the classic symptoms we find enumerated in the text-books. Still further, it is a noteworthy fact that fatal peritonitis may be observed to terminate the typhoid seizure, without any perforation being discovered on examining the intestine, and nothing unusual, perhaps, except either scybala in the colon (Herringham and Bowly - Brit. Med. Jour., 1897. i., 265.), perforation of the gall-bladder, rupture of the mesenteric glands, or abscess of the abdominal wall. We may take it, therefore, that since perforation of the intestine in typhoid fever may take place without suggestive symptoms, and as so-called characteristic symptoms may occur without any perforation having taken place, recovery from such symptoms cannot be deemed to be satisfactory.

Evidence of recovery from perforation in all of the recorded cases not operated upon; in whom, moreover, the mortality in pre-operation day (Murchison &c.) was actually estimated at from 90% to 95%. Rigidity of the abdominal muscles, and impairment of respiration,
must have considerable weight at a diagnosis; but too much reliance, however, should not be placed upon the fall of temperature, as it occurs in haemorrhage, and other conditions. Vomiting is very suggestive; so also evidences of obliteration of the hepatic dulness, and the hipocratic faces.

**Question of Operation.**

This is of vital importance; and as it cannot be denied that operative interference in cases of perforation is fraught with great danger to the patient, its inadvisability, or otherwise - without trespassing unduly upon the domain of the surgeon - may well be considered at this juncture.

To the American Surgeons (Wilson - Phila. Med. Times, 1886, vol. xvii, 177; Oushing - Johns Hopkins Hosp. Rep., vol. viii.; Finney - Annals of Surg., March 1897; and Keen - Jour. Amer. Med. Assoc. Jan. 20. 1890) we owe the introduction of operative measures in cases of perforation of the intestine. The dangers attending the same have been graphically described by Wilson (Loc. cit.), who states that granted that the chances of a successful issue are heavily against the operator; that the patient is in the midst, or at the end of, a long sickness; that his tissues are in the worst state to stand the injuries from the knife; that the lesions of the gut may be very extensive; that the vital forces are at the lowest ebb; - no one has yet hesitated to perform a tracheotomy in the laryngeal complications of typhoid fever, which require it to save life for these reasons. The operative treatment of purulent peritonitis has been performed many times successfully in conditions less primary. In point of fact the objections that may be urged against laborotomy in intestinal perforation in typhoid fever are no more forcible than those that have been made use of at first against the same operation in gunshot wounds of the abdomen. Unfortunately this question is not to be settled by experiments upon animals. The investigation must be made upon the human subject, where courage to perform it will come from the knowledge that the only alternative is the patient's death.

The similarity of the symptoms of intestinal perforations and the same condition in connection with the appendix is striking - as a matter of fact it is a common experience to find that they are identical, even to the usual location of the consequent peritonitis in the right iliac fossa. Why one class of cases should be left to die whilst operations are performed in nearly all cases of appendicitis - when perforation can be recognised, the patient, of course, not being beyond life - is inexplicable.
Analysis of Results in Recorded Instances—


(a) 40% to 50% operated upon under 15 years recovered.
(b) From 15 to 25 years of age 13% recovered.
(c) " 26 " 35 " " 20.8% to 26.93 recovered
(d) Over 35 years of age 41.7% to 45.5% recovered.

From this we may anticipate that operations for intestinal perforation are most fatal between 16 and 35, and least so under 15, and over 35.

Operations should never be attempted during the time of immediate primary shock, but the patient be allowed twenty-four hours in which to rally, but no longer, or fatal peritonitis will have had time to develop if that period be exceeded. Should the patient be moribund, operation must not, of course, be attempted. Delay is dangerous, and the sooner the case be operated upon - recovery from the primary shock being, of course, presumed - the better. If suspicious, therefore, of a perforation, one should not wait for an exact diagnosis, or for the peritonitis to reach a profound degree; but, on the contrary, an exploratory operation should be proceeded with in any case; it is free from intrinsic danger (Miculiez - Johns Hopkins Hosp. Rep., vol. viii).

It is sometimes surprising, nevertheless, how patients with even sundry additional complications recover (Van Hook - Med. News, Nov. 21, 1891, 591) Analysis of sixty cases, in which the interval between the onset of the perforation and the date of operation were shown, shows that; (1) 26.7% of recoveries were obtained in cases operated upon within twelve hours; (2) 30% between 12 and 24 hours; and (3) after 24 hours, with three exceptions, all died; hence if the operation be delayed beyond the latter period the outlook is hopeless.

Details of the actual operative technique are to be found in the works especially devoted to the subject. The procedure as now conducted - more especially if early - is attended by but little risk.

Cases of perforative peritonitis sometimes, where protective adhesions are formed in the neighbourhood, remain circumscribed, and ultimately recover spontaneously; or, on the other hand, do so by discharge of the abscess externally. Again, should a circumscribed abscess be located in inaccessible
situations (at the back of the abdomen, for instance), the case may drag on for months with indefinite symptoms, and ultimately prove fatal by evacuating its contents into some dangerous locality.

The circumscribed peritonitis may be localized to the right iliac fossa, the conditions being then termed "typhoid perityphlitis"; and to it special attention has been directed by Chomel and Gonzonnec (Thèse, Paris, 1881) who state that, when unrecognized, it causes trouble far into the convalescence. The condition runs the same course as ordinary perityphlitis, and calls for the usual operative interference. It must be remembered, however, that it may occasion some considerable difficulty in diagnosis, as in the cases described by Höscher (loc. cit) Rotitansky (Lehrbuch der path. Anst), Schomlein (klin. Vorlesungen), and others. The possibility of the peritonitis being due to the rupture of some other affected organ, must, obviously, be investigated.

The Mesenteric Glands—The condition of the mesenteric glands has been discussed in the anatomic section; and it is as well to remember that they too may soften and suppurate, or rupture, and cause diffuse peritonitis.

The Spleen.

In common with malaria, and other septic diseases, the spleen is nearly always markedly enlarged during the course of typhoid fever, especially in the fastigium, when its edge can usually be felt below the costal margins, or its bulk appreciable on percussion, and that even in the presence of tympanitis. The organ gradually increases in size, so as to attain its maximum enlargement at the beginning of the third week. In elderly persons, and those suffering from haemorrhage, it may, on the contrary, undergo an actual diminution. Infection may cause it to soften and suppurate, and thereby induce a general peritonitis. Intense pain in the splenic area would point to rupture; but, this, however, is of rare occurrence.

So constant is this splenic enlargement—both during the course of the fever, and in recrudescences and relapses—that it has now come to be regarded as of the utmost diagnostic significance, and more so than in many other diseases.

An enlargement of the spleen to double its usual size is usual; to three times—exceptional; and to six times—the maximum possible without rupture. The degree of enlargement, however, seems to vary with the character of the epidemic.

The spleen, however, may not be enlarged at all
in typhoid fever, for reasons such as the following—
(1) Antecedent emaciating disease leading to atrophy;
(2) intrinsic splenic disease — cirrhosis, hyper-
plasia, condensation of its capsule; and (3) haemorrh-
hage conditions — especially intestinal. Occasion¬
ally, again, the splenic tumour may be absent, and
without anything to a-account for the phenomenon.

The cause of the enlargement has been much
discussed and theorized upon; the most feasible views
being: (1) that of its consequences upon actual
presence of the typhoid bacilli in the organ, and (2)
the irritation produced by the circulating toxine.
The curious feature, however, is that the size
of the tumour bears no definite relationship to the
severity of the typhoid illness; as sometimes , even
in the mildest attacks it is of remarkable size , the
same attaining its maximum at the acme of the fever,
having commenced to be appreciable at the middle or
end of the first week of the attack; although in¬
stances of commencing enlargement, as soon as the
beginning of the stage of development of the fever, or
it may be , even during the incubatory period, are
by no means unfrequent (Friedrich - Volkmann's
Sammlung klin. Vortr.)

Until the enlargement of the spleen returns to
normal, the patient cannot be said to be quite free
from the infective process - so that the tumour has
now come to be recognised as a valuable index of the
patient's progress towards recovery. The fact of
the tumour returning during recrudescence and relapse
has already been noted.

The difficulties encountered in endeavouring
to demonstrate splenic enlargement by the ordinary
clinical methods, must be borne in mind - especially
if the observer by inexperienced, as also the fact
that the tumour may be obscured by meteorism, dis-
tended coils of the intestine or of the inflated
colon, displacement of the organ, its division into
several parts, supernumerary members, and so forth.
Percussion must, therefore, be carefully supplemented
by palpation by the bimanual method, as directed in
the works devoted to clinical medicine (Vide; von
Ziemasen - Klinische Seobacht. Über die Milz,
M. Med. Woch., 1896, 47; and Topographisch - klin-

Other conditions, as intra-splenic haemorrhage,
abscess, and rupture, present no special and dis-
tinctive clinical features, beyond, in the last two,
peritonitis, of a kind apt to be overlooked, and only
suspected by the occurrence of a sudden and acute
pain in the left hypochondrium, or by a process of
exclusion in diagnosis.

The pathologic lesions of the spleen have been
discussed in the anatomic section, and call for no repetition.

**THE THYROID GLAND.**

**Thyroiditis.**

The Thyroid gland is a rare participant in the train of affections of enterica; but in such it is, however, more often inflamed than in any other exanthematous disease. Walther (Inaug. Diss., Leipsic. 1896), reports forty cases of thyroiditis, due to typhoid fever, with symptoms of acute and painful enlargement of one or other lobe, or of part of a lobe. Such cases may proceed to suppuration, or by involution stop short of that; and it is seldom that dangerous complications - rupture, abscess, obstruction of respiration, and so forth - are observed. It appears beyond question that inflammatory affections of the thyroid are more frequent in goitrous districts (Switzerland especially) than elsewhere, the hyperplasia making the gland especially vulnerable to the typhoid bacilli - aided or not by pyogenic organisms. (Vide; Griessinger - loc. cit.; Liebermeister - loc. cit.; Schudmark and Vlachos - Wien. klin. Woch., 1900, 29; Toofer - Die Complicationen des Abdinaltyphus; MÜ. med. Woch., 1892; Jeansels - Contrio. À l'étude des thyroidites infect., Arch. Gén., July, 1893; and Lichtheim-Tavel - Ueber die Actiol. der Strumitis, Basle, 1892).
THE RESPIRATORY SYSTEM.

THE NOSE AND NASOPHARYNX.

These parts may present indications of the so-called "dry catarrh," at both the commencement of the illness and during its height; the congestive condition of the mucous membrane being easily appreciable (especially upon the inferior turbinated bones) on rhinoscopic examination; coryza is not usually present, or if so is not of typhoid origin. The discharge is not great, but should it accumulate in or about the narrowed nasal apertures, mouth breathing may be induced. Should the hyperaemia be excessive, blood may be expelled on sneezing, or upon blowing the nose; or it may be passed down into the pharynx, and consequently expectorated.

Epistaxis, however, appears (usually during the period of incubation, or immediately afterwards) in a large number of cases (7.5% - Leibermeister - loc. cit.), and is a valuable diagnostic symptom. It may occur also during the fastigium (especially the latter part of it), when, however, it is of no diagnostic (but of grave prognostic) significance; it is sometimes very intractable, or even fatal — after a longer or shorter period of induced debility. Nose-bleeding is common enough, in cases of haemorrhagic typhoid, at all stages, in whom, however, it is not usually fatal. It attacks, preferably, young persons — rarely after the age of forty-five, unless predisposed by alcoholism, and the like debilitations.

Diptheritic inflammation of the nasal mucous membrane when present, which is but seldom, occurs in association with similar processes in the neighborhood, as about the tonsils and pharynx.

THE LARYNX.

The larynx (with the joints) constitutes a very frequent site of typhoid complication; and for it the bacillus seems to have no accounting influence, as it has never — so far as a careful search of the literature can discover — been (or hardly ever) found there, under such conditions as could be regarded as definitely etiologic of the particular affection studied. The pathologic conditions noticeable, under a variety of circumstances, have already been referred to; but it may be further emphasized at this juncture that laryngeal ulceration presents features such as render it typical — i.e., upon the posterior wall of the cavity (seldom elsewhere), extending, it may be, to the adjacent attachments of the vocal cords, in the form of mere erosions in that situation.

Should, however, the ulceration extend to the epiglottis (which is not often), it is of minor
severity, and less dangerous than when confined to the larynx proper; and will be noticed, at laryngoscopic examination, in the form of small, shallow, rugged, ulcers; and sometimes also in association with ulcers upon the soft palate and tonsils. The occasional finding of tiny epiglottic ulcers has been noted before; extensive necrotic destruction is, fortunately, however, of great rarity (Moore - Trans. Path. Soc., 1865, vol. xxxiii.; and West - Ibid, p. 37), and is attended by great danger from aspiration pneumonia.

Short of immediate dangers, deep ulceration may induce oedema of the larynx, requiring prompt tracheotomy for its relief. Necrosis or abscesses of the laryngeal cartilages may be productive of fatality in the same way, especially when affecting the cricoïd and the arytenoids. The former is more often affected by the destructive process, but the latter may be so much so as to be actually expectorated. Severe cases like these call for immediate tracheotomy, followed by the intubation of the larynx until the parts are healed up; or, if cicatricial stenosis results, the canula must be worn permanently, should dilatation by bougies prove ineffectual. Luning (loc cit., p. 329) states that of his sixty cases which recovered after perichondritis eleven were able to do without the use of the canula, in from seven months to six years; the other forty-nine having to wear it more or less permanently, some at night only, and one of them continuously during a period of forty years.

The suppurative and necrotic process, again, may extend to the neck, or as far down as the mediastina, producing abscesses there, with or without general emphysema; cases illustrative of which have been reported by (1) Wilkes (Med. Times and Hosp. Gaz. 1862, ii., 276) - that of a child of twelve, who, on the twelfth day, developed general emphysema, consequent upon a perforating ulcer on the posterior wall of the larynx; (2) Chomel (Thèse de Paris, 1877) - emphysema in a man, aged twenty, from perforating ulcer of the thyroid cartilage; and (3) Durham (Holme's Syst. Surg., 2nd Edn. iv., 571) - one very similar.

The assertion of the older writers that perichondritis is never idiopathic but invariably secondary to ulceration of the mucous membrane, must be accepted with reserve, as it is by no means unusual to find the interior of the larynx apparently healthy in the presence of surrounding inflammatory lesions (De Brou - Presse méd. Belg., 1869, 21; Sekretan - Rev. méd. de la Suisse Rom., Aug., 1883; Luning - Die Larynx- und Tracheastenosen im Verlaufe des Abdominaltyphus und ihre Behandlung, Arch.f. klin. Chir. 1884, Bd. xx.; Pacchmayer - Verhandl-d. Würzburger med. Gesellsch., 1869; Gilliaud - Presse méd. Belg., 1869, 20; and Dutheil - Thèse, Paris,
Females, and children, are but rarely attacked by laryngeal ulceration, as compared with adults, and males who are specially predisposed to it by smoking.

The following table of Luning (Loc. cit.) shews the greater frequency of laryngeal complications between the ages of 15 and 25, and is probably due to the greater prevalence of the fever at that time:

<table>
<thead>
<tr>
<th>Age</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under ten</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Ten to fifteen</td>
<td>7</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Fifteen to twenty</td>
<td>30</td>
<td>11</td>
<td>41</td>
</tr>
<tr>
<td>Twenty-to twenty-five</td>
<td>56</td>
<td>12</td>
<td>68</td>
</tr>
<tr>
<td>Twenty-five to thirty-five</td>
<td>25</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>Thirty to thirty-five</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Over thirty-five</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>128</td>
<td>35</td>
<td>163</td>
</tr>
</tbody>
</table>

That laryngeal complications are predisposed to by locality, and the peculiarity of the typhoid epidemic has been contended, but lacks substantiation.

Laryngeal ulceration seems to occur most often during the height of the fever, and contemporaneously with the exfoliation of the intestinal sloughs; it has, however, been observed at an earlier period in severe cases.

Symptoms of Laryngeal Complication.

The fact that the patient, at the time when the lesions in the larynx are so wide-spread that they ought to be recognised clinically, lies in the typhoid apathy, and often makes no complaint of his sufferings, is a great hindrance to the clinician. All the more is it his duty not to allow slight complaints, especially if they arouse even a suspicion of any laryngeal complication to pass unnoticed. In the histories will be found the oft-recurring remarks; "The patient was doing well." etc. Physician and patient together rejoice over the daily progress towards convalescence; of the still slight but persistent trouble in the throat scarcely a word is said, until all at once—an exposure to cold, a little walk, is then blamed for it—the hoarseness increases, and swallowing becomes markedly painful. The picture now quickly alters. Soon, often within a few hours, come dyspnoea and suffocative attacks. Sometimes, even during the very first day, the anxious scene of laryngeal stenosis sets in, with stridor, inspiratory depression of the neck and chest wall—the unrest of despair, a struggle with death. The face become livid—the respira-
becomes rapid, wearisome; the auxiliary muscles of respiration are all called into play; sometimes the respirations are prolonged and noisy. The patient can find no rest; the dyspnoea even prevents the taking of nourishment; the expectoration of the increasing mucous becomes imperfect; soon attacks of suffocation occur. Either a tracheotomy must now be done immediately, or the patient, if he is weak, may choke to death, even in the first attack. More commonly, however, the attack subsides, and a slight improvement with short sleep will ensue. Expectoration of bloody mucus, masses of pus, and in some cases, even of pieces of cartilage, diminish the symptoms, and show at the same time that the real cause of the dyspnoea is not a catarrhal oedema or dropsical swelling but a destructive ulceration, even of the cartilages. Often, also, there is severe fever. Thus pass on, it may be even days and weeks, easy breathing alternating with the suffocative attacks. The alternative is only a finally fatal attack of suffocation or a late palliative tracheotomy with all its uncertainty. Perusal of the cases from suffocation without operation recorded in the literature shows that, almost without exception, suffocation occurred early and quickly, before either physician or patient had even thought of tracheotomy. This is a picture of a case of perichondritis. If the patient is in the stage of typhoid stupor, when the ulceration is accompanied with acute suppuration and swelling which may lead to destruction of the cartilages, the initial symptoms of the threatening danger may escape the attention of the physician entirely, in spite of careful observation. In these cases the objective signs of laryngeal stenosis, on which one usually depends, are much less marked; stridor, movements of the larynx, inspiratory depression, action of the auxiliary inspiratory muscles - in short, everything by which, in the healthy, we make the diagnosis of narrowing of the air-passages is, in the debilitated condition of the patient, far less outspoken, and easily deceives us to the degree of the danger of suffocation. The striking suffocative attacks, with arrest of respiration, so alarming even to the lay observer, are less noticeable, since the struggle of the patient with the mechanical obstruction quickly fails or is quickly abandoned. The condition passes into a death agony, with oedema of the lungs, without the diagnosis seemed to have reached a threatening degree; and thus one sees, often with astonishment, in the reports of the autopsies, how often the stenosis and destruction of the cartilages occur, as it were without any symptoms.

Fortunately, however, the state of affairs
depicted above, is not invariable, the ulceration being of a minor degree, and healing quickly without extension, so as to make an unfavorable prognosis in all cases unwarrantable.

Cases of post-typhoid paralysis of the laryngeal muscles have been described (Lyon Méd., Mar. 28, 1897, p. 453), Przedborski (Über Lähmungen der Kehlkopfmuskeln beim Unterleibs- and Flecktyphus, Sammlung klin. Vortr, Folge, 182, 1897), and Boulay and Meddel (Des Paralysies Laryng., Rev. de Laryngol et Rhin., 1895, xv. 615).

**THE TRACHEA AND ITS PRIMARY DIVISIONS.**

An occasional catarrhal inflammation of these parts occurs in the course of a typhoid attack, at an early period, and is indicated by a peculiar dry cough, pre-ternal pain, and tenderness, as well as the usual physical signs of the condition — the same, however, being seldom of a character as would warrant one suspecting the ulcerative conditions found at autopsies. Diphtheritic inflammations, whilst doubtless sometimes existing, are much less frequent here than about the nasopharynx. Pseudomembranous tracheitis has been reported in severe cases; so, also, a dangerous, and sometimes fatal, form of fibrinous bronchitis (Eisenlohr — Berlin, klin. Woch., 1876, 31; Griessinger — loc. cit.; and Brault — Progr. Méd., 1881. 19).

**The Bronchial glands.**

The particulars of the bronchial glands in the inflammatory processes contemporaneously with the mesenteric glands, is a matter of common observation, and is, doubtless, due to the direct action of the typhoid bacilli. The enlargement may be so great, in severe cases, as to exercise dangerous pressure upon the trachea or large bronchi, producing stenosis, as evidenced by the usual physical signs. The occurrence of suppuration in the bronchial glands is demonstrable only at the autopsy.

**The Bronchi.**

Bronchitis, as evidenced by the presence of innumerable sibilant rales, is seldom absent from a typhoid illness; and it has, therefore, come to be regarded as one of the specific symptoms of the disease, and as directly due to the irritation of the specific bacilli. The accompanying cough is of a dry nature, and attended with but little secretion —
thus distinguishing it from the bronchitis of typhus fever which is of much more marked character, and attended by copious secretion, and a most distressing cough. In enteric, however, it may be present (but only exceptionally), to a serious degree, in the stage of development; or to that extent later should the secretions be allowed to accumulate, or the patient be in the dorsal position, unconscious, and unable to expectorate. As a rule, the bronchitis is not a serious symptom. A severe grade of general bronchitis is favored by emphysema, senility, corpulence, and debilitated conditions leading to lobular infiltration - aspiration pneumonia.

Typhoid bronchitis is usually observed to be confined to the bases of the lungs - rarely to the apices, or the front; but, in severe cases, as already noted, it may be generalized, or even be attended by emphysema. Bronchitis of this kind seldom or never occurs in the other specific infectious fevers; so that the bronchitis element of enteric allows of considerable and important diagnostic interpretation. From a prognostic standpoint, moreover, an important point is that the earlier the bronchitis is, and the severer, the more the liability to subsequent pneumonia, and the same holds good as regards the risk of other pulmonary lesions.

THE LUNGS -

BRONCHO-ODEUMONIA, constitutes a comparatively frequent complication of typhoid fever, and is recognized by the usual symptoms and physical signs. The inflammation is regarded as being of a specific character; and Eberth's bacillus has from time to time been discovered in the sputum (Finfer - Die acuten Lungenentzündungen, Wiesbaden, 1889-1889).

The condition, if occurring in a person debilitated by heart disease, and the like, and if unrelieved, may progress so as to induce fatal oedema of the lungs; but, short of that, is responsible for the common complication of hypostatic congestion of the bases. It is always an unfavorable omen; and is commonest among those who happen to be suffering from disturbances of circulation (as heart disease) the debilitated, and in the dorsal decubitus. It may set in as late as the convalescence, and during relapses also. As it produces no extraordinary or special symptoms, it is apt to be overlooked; hence the necessity for careful examination in every case of enterica; by which means it can readily be detected.

Hypostatic Pneumonia - Although such cases as
the above usually recover with subsidence of the fever, and with the exhibition of suitable remedies, the condition may persist; the patient become worse; the temperature rise; rigors be felt; and the case develop by a process of extension of the infection, aided by the bacilli into one of hypostatic pneumonia; which is, perhaps, second to none as a dangerous, or fatal, complication of the fever (Liebermeister — loc. cit.)

Should, however, resolution occur, recovery is usual, and be far less likely to be interrupted by other pulmonary complications (gangrene, abscess, pleurisy, etc.) than would be the case if one of pure inflammation. The malady, moreover, seems to be less common in children than in adults; the former as a rule suffering from milder forms of typhoid than the latter who likewise are often subject to predisposing cardiac disease.

Lobar or Grounous Pneumonia

This is by no means an infrequent complication; and is nearly always due to the Frankel-Weichselbaum diplococcus; quite exceptionally to the bacillus of Friedlander. It is seldom that it is found to develop early, as it usually constitutes a late complication of the disease — in the third week, or thereabouts, sometimes even in the convalescence. It is interesting, and important, to note that it is subject to great variation, and unattended by the classic symptoms of lobar pneumonia (rigor, chills, cough, rusty sputum, pain etc.), and may be, and often is, overlooked. The temperature may not be elevated — especially in those patients who experience no initial chills or rigor — or perhaps, exhibit curious irregularities. Usually, however, the malady begins with a marked elevation of temperature, and is associated with great increase in the frequency of the pulse — in old and delibitated persons, moreover, with lowering of its tension and volume. These points should be kept in mind, and investigated as they may be all that may lead to a suspicion of this serious complication — cough, expectoration, and thoracic pain being either absent or obscured by the apathy or unconsciousness of the patient.

The sputum, as a rule, presents the ordinary characteristics of pneumonia, with the additional one of being even more sanguineous.

Lobular Pneumonia.

This is a rare complication of typhoid fever, so far as symptoms are concerned calling for no special description. Polynère (Thèse, Paris, 1889), however,
mentions a peculiar form of extensive consolidation due to the typhoid bacillus, (which, nevertheless, is difficult to isolate owing to the presence of the colon bacilli in these cases which closely resemble it) characterised by early onset, a rapid course, and a slow subsidence.

Lobar pneumonia is undoubtedly due, in many instances, in great part to streptococci and staphylococci; aided, it may be, by Eberth's bacilli; and it is the first which seem to be the most powerful in producing any form of pneumonia (Neumann - Berl. klin. Woch., 1889, Bd. viii.; and Finkler - Verhandl. d. Congr. f. inner. Med., 1888 & 1889) ; and these micro-organisms, moreover, undoubtedly exert their potency in producing aspiration pneumonia (Koch - Inaug. Diss., Leipsic, 1887). Septic pneumonia is always of late occurrence, Usually either late in the fastigium, or, more rarely, in the convalescence in the latter event being consequent upon a bedsore, or septic focus which if not apparent makes its diagnosis (as to etiology) exceedingly obscure, and sometimes defying recognition as to its septic origin unless the method of exploratory puncture be utilized.

Occasionally, and often as early as the first week, the pulmonary symptoms quite obscure the intestinal ones; the disease being then termed "Pneumotyphoid fever"; due to a special concentration of the poison upon the lungs. The onset may or may not be marked with a rigor, which is usually more severe than in ordinary pneumonia. About the end of the first week, the pneumonia symptoms abate, when the characteristic typhoid symptoms will come into prominence. Griessinger (loc. cit.), Hoxinansky (loc. cit.), Rindfleusch (Inaug. Diss., Würzburg, 1875), Gerhardt (Thüringisches Corresp., 1875, ii.), and Lépine (Rev. de Méd., 1878), as well as Jaccoud (ibid., 1880, t. xxviii.) have directed special attention to the frequency of this condition; whilst Leichtenstein (Loc. cit.) and Aufrecht (Loc. cit.), among others, deny it. The term has also been used to denote mixed infections of pyogenic organism with tuberculosis, during the disease.

Abscess of the Lungs.

This constitutes a rare, and late, complication of typhoid fever; and is nearly always either of metastatic pyaemic origin, or a sequel of typhoid pneumonia. If not fatal, pulmonary abscesses considerably retard convalescence. Ramsay (Annals of Surgery, Jan., 1890, 39) reports a case arising after the third week of the fever.

Gangrene of the Lungs.

Pulmonary gangrene seems to be of more frequent
occurrence than the foregoing. (although the contrary was believed by Murchison, and the older writers), and, like it, as a sequel of lobar pneumonia, and late in the disease, and predisposed to by debilitating factors, and vascular depression.

It is a speedy resultant of the pneumonia produced by the aspiration of the septic material from the pharynx and nose, or of the debris of laryngeal necrosis (Curschmann - Das Eleckfieber, Ziemassen's Handb. d. klin. Med., Bd. ii. 3. Aufl.) Gries-singer (Infections Krankh.) records an instance of gangrene of the lungs complicated by abscess in the spleen; and Liebermeister (loc. cit.) one of isolated gangrene in which none of the factors mentioned except, perhaps, great circulatory depression existed.

Pleurisy.

Pleurisy, with effusion or empyema, of itself, is by no means a frequent complication of typhoid fever, although commonly associated with typhoid pneumonia. When isolated, it occurs either late in the febrile period, or during the convalescence - one to two months after the fever. Exceptions to this rule, however, have been described, e.g., when the disease sets in at the beginning of the typhoid attack, and runs an extremely severe course; to this has been applied the term "pleuro-typhoid" (Lecorché and Talamon - Etude Mèd., 1881; Charrin and Roger - Soc. Méd. des Hop., Apr. 1891; Fernet - Ibid. May, 1891; and Germain - Sée - Die einfachen Lungenkr.). We have already noted that the pleural cavity was one of the situations from which Ebérh's bacillus was isolated as a pyogenic factor - Rendu and De Gennes (Loc. cit.) in 1885, and A. Fraenkel (Loc. cit.) two years after, obtaining pure cultures from the purulent effusion. As pointed out by Lartigan (Amer. Jur. Med. Sci., Jan. 1901), in the majority of cases of typhoid pleurisies, the aspirated fluid has been found to be purulent in character.

Pneumothorax.

This is one of the rarest of the complications of typhoid fever; and it occurs most often when infiltrated lobules at the periphery of the lungs become gangrenous, and perforate the pleura.

Pulmonary Tuberculosis.

It is but seldom that pulmonary tuberculosis can be traced to typhoid fever. It may occur either during the defervescence, or well into the convalescence. The miliary variety is the rarest of all; and
the symptoms do not depart from the ordinary.

THE CIRCULATORY SYSTEM

THE PULSE.

With the onset of the disease the pulse curve presents one of the following phenomena; either (1) the same kind of step-ladder ascent (and descent later) as the temperature - the usual; (2) a relative slowness (3) attainment of its acme before that of the temperature curve; or (4) a parellism with the latter. These features are attributed directly to disturbances produced by the toxine.

In young and healthy males, especially, the pulse often presents a peculiar infrequency, such as is never observed in other fevers, its average rate being about 84 to 100 in the morning, and 100 in the evening; so that a rate of 130 maintained would be of serious import. The temperature, moreover, may be of the typical kind while the pulse is normal or only slightly quickened; from which we conclude that the increase in the pulse rate cannot be due solely to the elevation of the temperature. The extreme debility observed in certain severe cases during the third week, may be attended by a very rapid pulse - 160 or more (the so-called "running pulse") - with or without marked irregularity.

At any time during the course of the fever, the pulse may present slight irregularity, which soon disappearing need occasion no alarm. Undue exertion, and mental excitement, often produce marked temporary acceleration. Dicrotism of the pulse always indicated lowered arterial tension; but this being an occasional feature of other infectious fevers, cannot be regarded as specific of typhoid. A subnormal pulse is frequently observed during the convalescence. The pulse temperature relationship - in spite of the assertions of Murchison and the older writers to the contrary - is manifest with greater constancy in typhoid fever than in any other disease, and constitutes a point of great diagnostic importance (Liebermeister - loc. cit., p. 91). According to Roger (Rech. clin. sur les de l'infance, T.i., Paris, 1872), the relative infrequency of the pulse to the temperature is usually not demonstrable in young children, the pulse in such being accelerated only.

The diminution in the pulse-rate is due to either irritation of the medulla, or to the depressors produced by the toxines or biliary acids in the circulation.

With the subsidence of the fever, the pulse becomes regular, and softer, from lowering of the tension of the arterial walls, which factor is also responsible for the di-- or polycrotism
of severe cases. A dicrotic pulse cannot, of course, be expected in patients with atheromatous arteries; and very rarely in children owing to the natural smallness of their vessels. Persistent acceleration of the pulse, as a rule, may be taken to indicate complications, especially of the lungs, heart, and intestinal haemorrhage, and peritonitis in addition. With the onset of the last, the temperature displays great inconstancy, and is sometimes not even elevated. Haemorrhage, again, produces a marked fall of temperature, with increase in the frequency of the pulse, so as to display a characteristic intersection of the two curves. In severe cases, when approaching a fatal termination, the relationship between the pulse and the temperature becomes entirely wanting - the pulse indeed may be scarcely appreciable.

The conditions described vary considerably under certain circumstances, e.g., in neurotic persons and irritable individuals, the pulse and temperature manifest great fluctuations, variations and irregularities.

During the convalescence - sometimes called the "stage of subnormal temperature" - the pulse is apt to be small, slow, and markedly subnormal (even as low as 40 in the evening, and 28 in the morning), and remains so for a longer or shorter period until the normal temperature register is permanently attained; but it sometimes exhibits departure from this rule without serious reason. The points enumerated, regarding the pulse, moreover, allow of diagnostic interpretation equal to that mentioned with reference to the temperature. When relative frequency of the pulse, fulness, and tension, are present during the fastigium, the prognosis would be favorable; not so, however, if the frequency be conspicuous at the onset of the disease, or early in the fastigium, particularly in elderly persons, and when accompanied by a correspondingly rapid elevation, or a fall, or temperature. Persistent irregularity of the pulse, especially early in the disease, as indicating cardiac failure, is of very serious omen - more so, however, inequality. A temporary irregularity in the febrile stage, or convalescence, does not indicate an untoward result, as it is common enough in women and children.

THE HEART.

It is not usual to find the heard sounds much altered during the course of typhoid fever. In asthenic and severe cases, however, the first sound may grow quite feeble, and gradually come to resemble the second - the so-called "embryocardia" - in which case a soft systolic murmur will be heard along the left border of the sternum.
Pericarditis is an occasional complication; still rarer is endocarditis; and comparatively common myocarditis — the last being responsible for collapse in cases otherwise apparently progressing favourably.

A transient, though sudden and alarming, disturbance of the heart's action, due to functional affection of the vagus and sympathetic nerves, is by no means infrequent. It may be noted, moreover, that brachycardie is a sequel of typhoid fever oftener than in any other infectious disease.

Death being so infrequent during the initial stage of the fever, considerable doubt exists as to the state of the heart muscle during that period, and as regards the assertion that disorders of action at that time sometimes noticeable are invariably functional in mild cases.

A certain amount of heart-softening has been stated (Laennec — loc. cit.) to occur in typhoid fever of a severe type.

Acute myocarditis, we have seen elsewhere to be responsible for serious cardiac affection in connection with which the researches of Hayem and Romberg (Loc. cit.) have been noted; to which may be added the specific obliterating endarteritis of the former, Martin (Rev. de Med., 1881 & 1882) and Landouzy and Siredey (Ibid., 1885 and 1887), and is usually noticeable about the end of the second week; and continues to the close of the defervescence, or longer; the symptoms being those essentially of rapid occurrence, intense cardiac weakness, infrequency, irregularity, and inequality of the pulse (without rise of temperature), with subsequent diminution in its volume, tension, and dicrotism. The peculiarity of the pulse, being so constant, may be considered as pathognomonic.

Symptoms of dilatation of the heart make their appearance soon after, or even with, the pulse change, and are usually confined to the left side, the right heart, if affected at all, being always so to a minor degree; the dilation of the heart upon the decline of the fever speedily disappears, and is not in itself of prognostic importance.

The apex beat, in severe cases, may be slightly weakened; and, in the severest cases only, inaudible; but this may not be attended by an increase in the area of cardiac dulness.

The presence of an enfeeblement of the first sound referred to, is noticeable only in the cases of extraordinary severity; at times indeed it may be quite inaudible, and the second feeble. The pulmonic sound occasionally undergoes marked accentuation from increase of pressure in the pulmonary circulation, consequent upon flagging of the left ventricle, and with this, again, may be heard, at the apex and
over the pulmonary area, a distinct systolic pulmonary valve murmur, due either to dilatation of the left auriculo-ventricular orifice, or to fatigue of the musculi papillares - one or more. Such conditions, curiously enough, are not - compared to the same in other diseases, diphtheria for instance - of serious import, as they rapidly disappear with the decline of the fever, or even before that.

Chronic myocarditis, is one of the rarest of all sequelae of typhoid fever; and is recognised by the, somewhat untrustworthy, symptoms indicative of heart failure, as dyspnoea, palpitation, and sense of heaviness in the precordia. The patient suffers from fatigue also upon the slightest exertion; mental inertia (with probability of chronic mania later on); gradual and positive disturbances of the circulation; cardiac asthma; symptoms of venous stasis in the liver, gastro-intestinal tract, and kidney; followed by oedema, angina pectoris, and cardiac arrhythmia.

The myocarditis of convalescence may last for months, and occasions the patient much uneasiness; but is, nevertheless, even when of the severest kind, and attended by general oedema, of favourable prognosis - although fatal cases have been reported by Liebermeister (Ziemssen's Pathol., 3rd. Ed.), and Zauber (Bayrisch. Arztl., Intell., 1870).

The exact change occurring in the myocardium, during typhoid fever, have been subjected to considerable investigation - as already noted - particularly at the hands of Virchow (Virchow's Arch. Bd. iv.), Hayem (Loc. cit.), Zenker (Loc. cit.), and Leyden (Zeit. f. klin. Med., Bd. iv. 1882).

The pericarditis usually participates in the inflammatory affection of the myocardium, but to such a degree as to produce marked pericarditic symptoms, or evidence of effusion. Zeller (La France Méd., 1881), and Le Clerc (Ibid., 1881, 54.) however, have each recorded an instance of purulent pericarditis; and Driguet (Cited by Michon - Contrib à l'étude des Suppur. dans la Fièvre Typhoïde, Thèse de Lyon, 1890) one of abscess of the wall of the heart, in a man, aged 56, who died on the thirtieth day.

Here, again, the endocardium is affected to such a degree as to cause clinical symptoms but seldom; and the infrequency of valvular lesions in typhoid fever is due to the myocarditis stopping short of extension to the valves. Ulcerative endocarditis, however, has been a few times observed - about the end of the second, or the beginning of the third week - as part of a septic typhoid. That the bacillus
of Eberth is capable of producing an endocarditis appears doubtful. The disease is usually located to the left side, and to the aortic very rarely - usually the mitral valve. These cases are apt to be confused with myocarditis with relative insufficiency, and it is only by means of a careful study, of the symptoms and case-history that the diagnosis can be ultimately determined.

**Collapse in Typhoid Fever**

The possibility of collapse in the course of fever is well known; and has been specially studied and reported upon by Ackerman (Virchow's Arch., Bd. xxv.), and Griessinger (Arch. d. Heilk., 1861). The accident is more apt to occur about the end of the stage of decline, or in the convalescence (though occasionally observable earlier), and is very often due to undue exertion, and so forth; but if manifested during a period of rest, it is seldom or never recovered from.

Cases of Typhoid Fever have been known to suddenly die, without the subsequent finding of any necrotic lesions to account for the fatality; and may be attributed - as suggested by Romberg (Berl. klin. Woch., 1895, 5, 152), and Pässler (Vernhandl. d. Congr. f. innere med., Wiesbaden. 1896) - to the vaso-motor disturbance produced by the circulating toxine.

**THE BLOOD VESSELS.**

"**TYPHOID ARTERITIS**" - so-called - is of common occurrence, and is probably responsible for the spontaneous gangrene of the extremities sometimes observed in typhoid patients - the bacillus having been discovered in the arterial walls.

**GANGRENE**

Gangrene is most often observed in one of the lower extremities, and may be so severe as to involve the middle of the thigh - the main arteries having been thrombosed.

It is to the French writers that we owe our knowledge of this remarkable disease. Fabre (Gaz. méd. de Paris, 1851), Larrey (Mém. et Campagnes, i. 72), Alibert (Thèse de Paris, 1836), and Hildebrand (Typhus Contagieux, 1806), doubtless, mention it; but it was Bourgeois (Bull. Soc. Méd. des Hop., Paris, 1857, iii., 311), and Bourguet (Gaz. Hdbd., 1857, 646), who, in 1857, directed special attention to the frequency of its occurrence in typhoid fever. Some years afterwards, viz; in 1861 and 1863, Gigon (L'Union Méd.) and Putry (Arch. Gén., 1863, i., 129, 549) emphasized the fact of the gangrene being due to
arterial thrombosis; but regarded it as more of a
coincidence than a consequence of the fever. Since
then, the disease has been frequently reported, and
described, and notably by: Keen (Op. cit.), David
(La Gangrène Typhoïde, Thèse de Paris, 1893), Des-
champs (L’Artère aigüe dans le cours de la Fièvre
Typhoïde, Ibid., 1886), Flexner (Johns Hopkins Hosp.
Rep., Nov., 1894, 120; and Jour. Path. & Bactérol.,
Nov. 1894. i., 202), Spillman (Gangrène des Organes
Génaux de la Fèvre Typhoïde, Ibid., 1886), Flex-
ner (Jolws Hopkins Hosp., Nov., 1894, 120; and Jour.
Path. & Bacterol., Nov. 1894. iii., 202), Spillman
(Gengrène des Organes Génaux de la Fèvre, Arch. Gén.,
1881, 7th Series, vi., 150), Barie (L’Artère aigüe conséq.
à la Fièvre Typhoïde, Rev. de Méd., 1884, i., No. 1)
Haus-halter (Merc. Méd., Sept. 20, 1893, 453) and Quer-

Gengrène, however, is by no means a common com-
plication or sequel of typhoid fever; for we find no
mention of it in the 2000 fatal cases of the fever
tabulated by Holscher (Munchener med. Woch., 1891,
xxxviii., 43), although thrombosis of the femoral
vein was found in fifty-nine; and its occurrence
noted is only four of the 1420 of the typhoid necrop-
as Bettké (Inaug. Diss., Basel, 1870).

**Classification.**

For convenience of description, cases of ty-
phoid gangrene may be classified as follows;

A. Pressure Gangrene.
B. Spontaneous Gangrene

A. Pressure Gangrene;

This category includes cases of bed-
sores, which seem to be more common in typhoid than
any other febrile disease, owing to its great debil-
itation and long duration.

Apart from the risk of pyaemia if neglected,
the typhoid bed-sore has been known to extend to
such a depth as to eat through the sacro-coccygeal
ligaments and sacrum, thereby opening up the spinal
canal and inducing meningitis (Blandin - Anat. Top.,
Nerveux, 2nd Edn. i., 89, 90; and Néleton Path. Chir
Jour., 1867, 297) reports tetanus as following a
bed-sore. The bed-sore may contract so much as to
impair the movements of the lower extremity; Chendu
(Rapport, pp. 520, 524) reports an instance of
this condition.

As emphasized by Stokes (Fever, Philadelphia,
1876, 210), as slight amount of neglected pressure
may induce an extensive gangrenous process - his
patient having no less than thirty necrotic foci, re-
sulting from the trifling pressure produced by the
breasts, reclining upon the arms, one leg over
another, or the face resting on the hand.

B. Spontaneous Gangrene

Cases of this variety vary in frequency according
to the severity of the illness and of the epidemic, as well as the condition of the patients as regards previous health and surroundings, as pointed out by Estlander (Arch. klin. Chir., 1870, 453), who reported 43 cases, and in 1867, before the distress occasioned by the former had been well recovered from, the epidemic not subsiding until the plentiful harvest of 1868.

The complication usually develops towards the end of the fever, or early in the convalescence - when the patient is apparently progressing satisfactorily - and is characterised by sudden severe pain at the site of the impending necrosis, or over the thrombus, radiating from the latter to the periphery; or, in the case of the lower extremities, to the great toe or heel. The pain, however, soon gives way to definite local symptoms - numbness, anaesthesia, impairment of mobility - and the usual signs of gangrene.

These cases heal very slowly; Barker and Cheyne (Account of the Fever lately Epidemic in Ireland, London, 1821. vol. i. p. 232) reported a case which terminated fatally in the remarkably short time of two and one-half hours after the onset of gangrene of the nose.

Should recovery result, the thrombosed artery seldom recovers its patency; it being probable that the vessel becomes pervious by means of the coalescence of its vasa vasorum (Pétres - Edin. Med. Jour. Aug. 1875 p. 175).

It is far from unlikely that certain cases of brain-softening, seem towards the end of the febrile stage of typhoid fever, may be due to thrombosis of the supplying cerebral arteries; Welch (Thrombosis and Embolism - Allbutt's System of Medicine, London, 1899, vol. vii.) reports four cases of thrombosis of the middle cerebral artery, or its branches death occurring in ten hours after the onset of the condition.

Should, however, the gangrene be of the variety in which no thrombus exists, i.e., due to either extensive stasis of the capillary circulation of the part (nose, ears, penis, perineum, labia, feet, fingers, etc.) or fatty degeneration of the smaller arteries from spastic ischaemia (Raynaud - De l'asphyxie locale et de la Géngrène symétrique des Extrem., Paris, 1862), the symptoms will vary somewhat from the foregoing; for it is not so constantly in the lower extremities, and is more apt to be symmetrical; and, if small in amount, the pain is of much lesser intensity. The gangrenous process, moreover, is observable much earlier, and progresses more quickly, and attains its limitation in a few days - not being dependent upon a growing thrombus. For the same
reason, it may return in the stump after amputation, and is always of comparatively small dimensions. Death, moreover, is rapid, failing which reaction is speedy; the special illness, therefore, is never protracted.

Typhoid gangrene may leave dreadful deformities - especially about the head, ears, and orbits - it has ever been seen to lay open the chest wall, and mediastina (Fraentzel - Berl. klin. Woch., 1874, xi., 97; Werner - Med. Corresp. Württem. Aerztl. Verein. Stuttgart. 1859. xxix. 76); and Hoffmann -(loc cit.; p. 388).

The genitals, when attacked, are more often those of the male - the female possessing a comparative immunity - which, in view of the intrinsic predisposing conditions, is remarkable. The process usually produces no untoward result; Murchison (Fever., p. 194), however, instances the loss of thirty ounces of blood from a gangrenous scrotum. In the case of the female the trouble is nearly always confined to the vulva or vagina, occasionally extending from thence to the perineum and thigh, or, it may be, leading, apart from that, to stenosis of the vaginal orifice (Russell - Glasg. Med. Jour., 1864 - 65 xii. 165); atresia of the vagina (Guenean de Mussey Gaz. hebdom., 1867, 652); or recto-vaginal fistula (Lebert - Anat. Path. ii. 307; and Liebermeister - Ziemssen's Cyclop., vol. i. p. 184).

As regards the date of onset of typhoid gangrene, it may, in contradistinction to the bone lesions, be noted that it is never of early occurrence, nearly always towards the end of the febrile stage, and never before the fourteenth day (Donald - Lancet, 1892, i. 417), or after the seventh week (Forgues - Rec. de Méd. Mil., 1880, 3rd. Ser. xxxvi. 386) - the usual time being in the second or third weeks of the fever. The late onset of gangrene is accountable for on two grounds; (1) the preponderance of the patient's vitality over the fever in the early stage of the latter; but mainly (2) the time taken for the development of the bacilli and formation of the toxines; which, by the end of the second or third weeks have thoroughly invaded the system, when the latter, by privation of nourishment, the pyrexia, and weakening of the heart's action, has become both debilitated and emaciated.

Venous Thrombosis. Thrombosis of the veins may induce gangrene, which, in contradistinction to that produced by arterial thrombosis, is nearly always moist. It does so in about 1 per cent. of all cases (Murchison, op. cit.), and is said to be more frequent than the arterial form owing to (1) the sluggishness of the circulation, and (2) the possibility of venous
inflammation.

Plebitis;

Plebitis is a common cause of phlegmasia dolens; which, though usually recovered from, may be protracted and annoying; it is usually unilateral.

The relative infrequency of gangrene from venous thrombosis is due to the collateral venous channels being less often obstructed than the arterial by-ways, the obstruction of which latter causes complete ischæmia of the parts beyond.

Venous thrombi may be very extensive, as well as multiple, the cases reported by De Santi (Rec. Méd. de Méd. Wilit., 3rd. Series, vol. xxxv., 1879, 502), Dumont-pallier (Comotes Rendu Soc. Biol., 1879, 6th Ser., vol. iv. 2 & 3), Bouley (Progr. Méd., 1880., viii. 998), and Sorel (L'Union Méd., 1882, 3rd Ser., vol. xxxiv., 521), having each a clot extending from the deep femoral vein to the vena cava inferior; that of Beaumanoir (Progr. Méd., 1891, ix., 364) showing, in addition to numerous clots in the arteries of the lower extremities, fibrinous clots in the right ventricle, pulmonary vessels, the left auricle, the femoral arteries and veins, as well as in the aorta, extending into the first intercostal artery. Mackintosh records (Glas. Med. Jour., 1892, xxviii, 54) the extraordinary fact of a case, similar to the above, having recovered.

Patients suffering from venous thrombosis are always subject to the risk of sudden death; and cases of this accident are described by Nauwerck, (Corresp. Schweiz. Aerzte, 1879, 485), and Bouley (Loc. cit., 1880. vii. 998)

Gangrene of this kind may display a symmetry closely resembling that of Raynaud's disease; Richard (L'Union Méd., 1880, 3rd. Series, xxix, 1025) reports two cases of the phenomenon.

The probability of typhoid plebitis being due to Eberth's bacillus has not yet been determined; the writer is inclined to adopt the view of Dunin (Deut. Arch. f. klin., Bd. xxxix, Heft. 3 u. 4) and others, that pyogenic organism participate in the process.

THE BLOOD IN TYPHOID FEVER

The blood presents certain alterations in typhoid fever, some of which are useful to the diagnostician. Should profuse sweating or copious diarrhoea be features of the illness, a relative increase of the red corpuscles will be noticed. An actual diminution of their number, however, is seldom observed before the end of the second week; and this may be well marked during convalescence—in severe attack especially. The condition of the haemoglobin is of importance; it is more apt to be relatively decreased than the number of the red
corpuscles.

The number of the white corpuscles undergoes little or no diminution until late in the convalescence, when it sinks, giving an average count of 2,000 per c. mm., furnishing an important means of distinguishing an ordinary attack of the disease from leucocytosis. Leucocytotic affections do indeed occur in typhoid fever complicated with haemorrhage or perforation; but more so in connection with large abscesses, phlebitis, peritonitis, pneumonia, pleurisy, periostitis, cystitis, and cholecystitis (Thayer - Johns Hopkins Hosp. Rep., vol. viii.) The cold bath treatment has also been known to produce a leucocytosis, which, however, is only temporary, and disappears upon the procedure being abandoned. Naegeli (Deut. Arch. f. klin. Med., Bd. 67, Heft. 3 u. 4) described his finding of an early neutrophilic leucocytosis of a moderate degree, and temporary duration. In the fastigium neutrophiles and lymphocytes undergo still further decrease, the former at last disappearing, while the latter begin to increase, and continue to do so until defervescence. During the stage of decline the neutrophiles reach their minimum, the lymphocytes are greatly increased, and the eosinophiles gradually return to their normal number. A lymphocytosis may, however, occur after the disappearance of the fever (Schottmüller - Deut. med. Woch., Aug. 9, 1900; Castellani - Rif. Med., vol. i. 6 & 7; and Auerbach and Unger - Deut. med. Woch., Dec. 6. 1900).

# Presence of Typhoid Bacilli (in the blood)

## A. In the General Circulation.

Examination of the blood during the course of typhoid fever for long furnished no uniform confirmation of the suspicion of their existence there. Gaffky (Loc. cit.), Lugatello (Boll. d. Roy. Acad. di Genoa, 1881) and others failed to find the bacilli in the blood at all; Weissel (Wien med. Almquist. [Goteborg, 1885]), being only able to demonstrate their presence very occasionally. Since then, however, Cole (Johns Hopkins Hosp. Bull., vol. xii. 124), Schottmüller (loc. cit.), and others, have proved their absence to be quite exceptional. The following represents some of the findings:

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<th>Observer</th>
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Kanthack and Tickell (Edin. Med. Jour. July, 1897, 22) and Ohlmacher (Cleveland Med. Gaz., May, 1897), have demonstrated the bacilli in the blood in mixed infection with streptocci.

B. In the Roseolae

The same divergence of research is displayed here also. Neuhauss (Loc. cit., 1886, 6 & 24) has demonstrated Eberth's bacilli in the rose spots in 9 out of 15 cases examined; but Janowski (Loc. cit.) and others, have entirely failed to secure confirmatory results. With improved methods of examination, however, the bacilli have been detected in the roseolae with considerable constancy (roughly 90%), so that we may conclude that their apparent absence is entirely due to defective investigation.

C. In the Splenic Circulation.

From the constancy of the enlargement of the spleen during the course of typhoid fever; and the frequent finding of the bacilli in the splenic substance, in great number, after death, we may presume their presence there during life - in the pyrexial stage at least. The fact of Vincent (Ann. de l'Inst. Pasteur, 1893, vii. 141) Flexner (Jour. of Path. & Bacteriol., 1894, iii. 202) Neisser (Zeit., f. klin. Med. Bd. xix.), and Philipowicz (Wien. Med. Blätter, 1886, 6 & 7) having indeed produced substantiative evidence of this has led others to propose exploratory puncture of the spleen for the sure diagnosis of enteric fever; but this, as urged by Stagnitta (Rif. Med., 1890) is inadvisable owing to the inconstancy of the finding; as well as the risk of fatal rupture of the organ.

D. In the Placental Circulation.

The frequent finding of the bacilli in the placenta in cases of abortion during typhoid, still further confirms the opinion now held as to their diffusion by means of the circulation. Chantemesse and Widal (Loc. cit.) moreover, have found them in great abundance in both foetus and amniotic fluid.
THE NERVOUS SYSTEM.

Disturbances of the nervous system being so frequent, from the incubation to far into the convalescence, has led to its sometimes being termed a nervous fever.

Headache;

This is almost always present and distressing, commencing usually in the first week, or during the early part of the second, it is of an intense boring; or stabbing character, likened sometimes to the effect produced by wearing a tight band round the head, and is experienced most in the occiput and temples. In severe cases it is accompanied by intense spinal pain, or actual neuralgic affections of the supra-or infraorbital nerves (Rosenbach - Deut. Arch. f. klin. Med. Bd. xvii.); and with its subsidence, in the second week, a condition of stupor or apathy remains; so that a persistence of headache beyond that time would justify a suspicion of cranial complication.

Insomnia.

Sleeplessness is specially apt to be complained of during the time that the headache is troublesome; and its transition into somnolence is usually interpreted as a favourable symptom.

The "Typhoid State."

By this is meant the condition of stupor and hebetude, with dry, brown, tongue; sordes on the teeth; rapid, feeble, pulse; incontinence of faeces, and urine; and rapid emaciation; which is seen in the fully developed fever - the term being, however, also applied to the same condition seen in other adynamic diseases.

Delirium.

This is frequently observed in typhoid illnesses of the more severe kind; but some fairly severe cases are, nevertheless, entirely free from it. It comes on at night, or at times when the patient is left alone.

The patient's delirium frequently prompts him to leave his bed; but as a rule, the delirium is of a mild kind, noisy, and accompanied by considerable restlessness. He then remains somnolent in bed, muttering to himself in a loud whisper - the so-called "typho-mania", which condition gradually gives place to coma towards the end of the fastigium. On the other hand, however, coma may be developed suddenly, and be accompanied by carphology, or by grasping at imaginary objects, and this in cases approaching a fatal termination.

Delirium tremens is not infrequently induced by the typhoid attack in alcoholic patients; or, again, in neurotic cases, the delirium may assume the hysterical type, characterised by emotion or extreme
sadness.

In the most extremely severe cases, even in the robust, the delirium may assume the form of a profound coma resembling an intoxication - the patient lying quite inert, with the skeletal muscular system relaxed, the mouth open, sordes on the lips, and teeth and tongue, and stertorous respiration. The urine and faeces, in such cases, are voided in bed, and the reflexes are observed to be abolished.

The condition, coming on as it does as soon as the first week of the fever, may persist into the third - the temperature throughout being lowered to a marked degree.

The Motor nerves;

In association with the condition of stupor, and delirium noted, the motor nerves present evidence of disturbance. Slight twitchings of the muscles of the face are common enough in the debilitated, irritable, and alcoholic - even during the initial stage of the fever; so also, severe motor disturbances, of a transient kind, towards the close of a moderate attack. When affecting the tendons of the wrist, and hand, the jerkings are designated "subsultus tendinus". In protrusion of the tongue, the tremors may be seen to be affecting the member also; as well as the jaw, and lower extremities - with more or less constancy. Much tremor is usually associated with deep ulceration, but it may arise from toxaemia only.

Condition of the Reflexes.

The deep reflexes are usually increased contemporaneously with this motor disturbance; but may be absent, or diminished without peripheral nerve change. In severe cases, towards the end of the defervescence, or early in the convalescence, the patellar reflexes may be markedly exaggerated; and, occasionally also, that of the tendo Achilles. The former, in cases of moderate intensity, may, however, be entirely abolished; but it usually undergoes little or no alteration.

Chief amongst the nervous complications is paralysis (usually regarded as due to a neuritis), which may affect one or more nerves, causing paralysis of one limb, or a true paraplegia. Hemiplegia may result from thrombosis of the cerebral vessels, or local encephalitis, and is sometimes attended by convulsions.

Aphasia may be either a sequel or a complication; it is nearly always temporary; and is said to be commonest in children.

As a sequel of the typhoid attack, more or less mental enfeeblement may be noticed; the patient sometimes having then no recollection whatever of his previous sufferings, and may perhaps
for ever.

Sudden and acute, insanity may develop in the convalescence, especially if the patient be predisposed to it. In most cases, a confusional insanity due to interference with the functions of the nerve centres—may be observed; in others the mental defect may take the form of a true melancholia.

Chorea, of a minor character and sometimes unilateral, may be encountered, and is a rare complication; it is usually recovered from in a week or two—although it has been known to persist for as long as one year.

Paralysis Agitans Attention was first directed to this sequel by Benedikt (Lehrbuch der Nervenhr.); it is always late on onset; and of a very chronic character.

Exophthalmic goitre, as a sequel of typhoid fever, is of great rarity.

The same may be said for diabetes insipidus.

"Typhoid Spine"—This consists in the onset of severe pain in the spine, and the legs, more especially upon movement. It is said by the original investigator (Gitney—loc. cit.), to be of the nature of a perispondylitis. It recurs during the convalescence in neurotic persons, and is usually regarded as akin to the "hysteric apine", and to the "railway spine."

Neuralgias—of the head, constitute common complications and sequels of the typhoid illness; whilst great hyperaesthesia especially of the lower extremities) is by no means infrequent.

Peripheral Neuritis—This has often been seen as a complication towards the close of the febrile stage—the manifestations being more those of a sensory character than of a motor disturbance; and sometimes nothing more than a persistent numbness of the upper or lower limbs; at other times, again, it may assume the form of intense, or agonizing pains in the areas of distribution of the sciatic, ulnar, or other nerves.

The feelings of numbness, or of pain, may last several weeks, and be succeeded by anaesthesia—the latter being sometimes known to develop a more or less chronic tendency. The muscles affected—especially those of the forearm—may undergo either paralysis or atrophy, and be followed by contractions.

Cases of paraplegia, due to lesions of the peripheral nerves, have from time to time been reported by Alexander (Deut. med. Woch., 1886), Henoch (Charité-annalen, 1892), Cadet de Gassicourt (Traités clin. des mal. de l'enfance, 1882, T.11), and others; whilst occasionally the neuritis may
develop without atrophic paralysis.

**OCULAR COMPLICATIONS.**

A. THE OPTIC NERVES AND RETINA-

**Optic Neuritis**

This is of somewhat rare occurrence; it may be double; and usually leads to optic atrophy, though cases of complete recovery have been recorded by White (Trans. Ophthal. Sect. Amer. Med. Assoc., Chicago. 1893, 215 - 223), Clarke (Jour. Amer. Med. Assoc., 1891, xvi., 473-476), and others.

According to Oglesby (Brain, London, 1882, v., 197-293), optic neuritis never occurs in a case of typhoid fever without having either meningitis or cerebral affection associated with it. Braine-Hartnell (Brit. Med. Jour. May, 29, 1897) has proved from an actual case that double optic neuritis may complicate typhoid in the absence of the conditions insisted upon by that observer.

**Optic Atrophy.**

This may be partial or complete, single or double; and may either follow the neuritis, or occur quite independently. The amblyopia is usually complained of during the convalescence; and may be caused by the excessive exhibition of quinine during the febrile stage, intestinal haemorrhage (Williams - Arch. of Ophthalmology, New York, 1884, xiii, 39 - 399), or excessive metarrhagia during the fever.

**Retrobulbar Neuritis -**

This may lead to a temporary or permanent impairment of vision, which may or may not end in optic atrophy; it is probably due to haemorrhage in the nerve.

A transient form of amblyopia, without discoverable anatomic change, has been described, as an occasional complication, by Nothnagel (Deut. Arch f. klin. Med., 1872, ix. 470).

**Retinal Anaesthesia -** As induced by the circulating toxine, this has been noticed by Stewart (Montreal Med. Jour., 1894. xxiii, 752 - 758).

**Neuro-retinitis -** This complication, with haemorrhage into the macula, has been reported by Munier (These de Paris, 1874), and von Peterhausen (Detroit Rev. Med. & Pharm., 1873, viii, 533-541), as leading to blindness.

Retinal haemorrhages, are not so uncommon, and occur about the third week of the fever; may burst into the vitreous; and be associated with intestinal haemorrhage. The exact cause of the
condition has not yet been determined, but is probably that of a weakening of the vascular wall due to impairment of the nutritive quality of the blood.

Embolism of the Arteria Centralis Retinae.

This is most commonly encountered during the convalescence; instances have been recorded by Snell (Ophthal. Review, i., 403), Galezowski (L'Union Méd., 1877, 3rd. Ser., xxiii., 937-941) and others.

B. THE CRYSTALLINE LENS;

Cataract; may well be expected to, and often does, occur—consequent upon the inflammatory affection of the uveal tract causing interferences with the nutrition of the lens. Independent of this, however, a cataract may constitute a sequel of the constitutional disturbance produced by the fever (Fontan—Rec. d'Ophthalm., 1887, 3rd S., ix., 195-200), and Trélat—Gaz. des Hop., 1879, p. 417).

C. THE UVEAL TRACT AND VITREOUS HUMOUR.

1. The Oveal Tract;

The inflammatory affections of the iris, ciliary body, and choroid, are occasionally seen during the course of typhoid fever—in the convalescence particularly. Sorel (Bull. et Mém. des Hop., 1889, vi., 3rd S. 324-246), in 871 cases of enterica, found iritis once only.

II. The Vitreous.

The inflammation of the vitreous humour may produce only an opacity, or go on to suppuration; it is found only in very debilitated persons.

D. THE CONJUNCTIVA AND CORNEA.

Complications affecting these parts are amongst the most frequent of all ocular complications.

Conjunctivitis of the catarrhal variety, is very often seen during the typhoid illness; and the phlyctenular variety during the convalescence (Knies—Die Berziehungen des Sehorgans und seiner Erkrank., zu dem Überbringen des Körpers und seiner Organe, Wiesbaden, 1893; p. 395); and, being common to febrile conditions, need occasion no alarm.

Keratitis, of the ulcerative variety accompanied by sloughing of the cornea, on the contrary, is a vastly more serious condition; and is likewise observable during the convalescence when attended by great debility (Alt—loc. cit.; Knies—loc. cit.;
A rare complication is that of xerophthalmia, or xerosis corneae; which has been reported by Bull (NY. Med. Rec., 1897, vol. 51, 577) as occurring in the comatose cases of typhoid fever; to which, however, it is not peculiar, as it is seen in cholera, meningitis, and severe diarrhoea.

EXTRA-OCULAR AFFECTIONS;

THROMBOSIS OF THE ORBITAL VEINS.

This; (with phlegmon of the orbit) is perhaps the rarest of all ocular complications. Panas (Congr. Francais de Chir., 5th Session, Paris, 1891, 63 - 69) reports a severe instance of phlegmonous inflammation of the orbit, and panophthalmitis, with angioma of the bulbus - the centre of which was found to have suppured, and to contain Eberth's bacillus.

ORBITAL HEMORRHAGE.

Finlay reports a case of this condition in the third week of typhoid, which was associated with intra-ocular bleeding and ecchymoses in both the conjunctivae, as well as over the entire body and limbs - the affection being, therefore, really part of a complicating purpura.

AFFECTION OF THE OCULAR MUSCLES.

A. Paralysis of the Intra-ocular Muscles.

Paresis of accommodation is by no means infrequent during the convalescence; dilation of the pupil, sometimes seen at that time, being due, as pointed out by Segal (Arch. f. Augenh., Wiesbaden, 1889, xix. 386) to irritation of the sympathetic only.

B. Paralysis of the extra-ocular Muscles.

The extra-ocular muscles are but seldom affected by paralysis; and, when so, the condition may be interpreted as indicative of grave intracranial complication. Muscular paralysis is rarely encountered before the third week; more often in the convalescence, in association with renal insufficiency; whilst the affection appearing months after recovery would probably point to a meningeal sequel (West - St. Barthol. Hosp. Rep., 1886, vol. xii., p. 224).

Hemihypoa is an exceedingly rare complication; and in etiology resembles the foregoing.

AURAL COMPLICATIONS.

The ear, of the organs
of special sense, is the one which is most often affected in typhoid fever. Bezold (Ueber die Erkrank, des Gehörgangs bei Ileotyphus, Arch. f. Ohrenh., 1884), in 1243 cases of enterica, found impairment of hearing in 48, and Burkner (Beit, zur Statistik der Phrkrank. Arch. f. Ohrenh., Bd. xx.) the same in 1.6%.

Functional Disorders - e.g., various nausea - are common enough during the fever; but, though, extremely annoying, quickly disappear upon its subsidence, or early in the convalescence.

Some mention of middle ear complications has already been made; the exact role played by Eberth's bacillus in them has not yet been determined.

Middle-ear affections, moreover, are less common, and of more unfavourable prognosis, in typhoid then in any other similar disease.

Gangrene of the external auditory canal is an extremely rare condition; so also periostitis; and abscess of the aural cartilages - secondary to parotid affection. Furunculosis is somewhat more common; and is then associated with boils elsewhere.

C E R E B R A L C O M P L I C A T I O N S.

Thrombosis of the Middle Cerebral Artery.


Cerebral Abscess.

Actual cerebral abscess is of extremely rare finding, and nearly always as a participant in some septicaemic condition. Being usually associated with purulent meningitis, the symptoms induced are almost invariably of that condition.

Meningitis; Meningitis - a frequent cause of hyperpyrexia - is not a common complication of typhoid fever; it is often cerebro-spinal. It may either introduce the disease (with the usual severe headache, vomiting, retraction of the head, squinting, etc.) or occur during its course; and is usually of toxic origin. The finding of Eberth's bacillus in such cases is quite exceptional; and the condition goes by the name of "cerebral typhoid".

Later in the course of the fever, meningitis has been observed, but still with great rarity,
having its origin in middle-ear disease. The autopsies of such cases have revealed the streptococcus and the pneumococcus (very rarely the typhoid bacillus), in the meningeal effusion.

Kernig's sign is useful in diagnosing the condition, and consists in the impossibility of obtaining complete extension of the leg when the patient is sitting and the thigh is flexed at right angles to the trunk. The sign is produced by irritation of the meninges of the lower portion of the spinal cord, and of the nerve roots which constitute the cauda equina, although it is no indication of a distinct lesion of these structures (Roglet - Gaz. hebdomad. de Méd. et de Chir., July 15, 1900). Under this irritation - increased by the stretching of the sitting posture, the tenacity of the flexor muscles of the leg is increased; and, as a consequence, complete extension of the leg becomes impossible.

The contraction disappears when the patient assumes the dorsal decubitus. If the patient cannot be propped up in bed, the thigh may be flexed upon the abdomen, when, if meningitis be present, complete extension of the leg will be prevented by the contraction of the flexor muscles. Head's statistics (St. Paul's Med. Jour., 1900), embracing 156 cases, show that Kernig's sign is present in 84% of the cases of meningitis, but is present likewise in all meningeal affections. The time of its appearance is variable; in order to be certain that the sign is not present, it should be looked for repeatedly. Again, the time of its disappearance varies; it may disappear during the preagonal period. The value of the sign is real; but its absence in any case does not justify the exclusion of meningitis in the diagnosis. Herrick (Amer. Jour. Med. Sci., July, 1899) points out that, from its persistence into convalescence, it may be of service in enabling one to make a retrospective diagnosis.

Meningitis during a typhoid attack is always to be considered as of grave omen; it is usually the cases due to thrombosis that recover.

**AFFECTIONS OF THE CRANIAL NERVES.**

**A. MOTOR DISTURBANCES.**

Cranial nerve affections constitute rare complications of typhoid fever - especially paretic affection of the seventh and twelfth. Actual paralysis of accommodation has been reported by Kittel (Wien. med. Zeit., 1865), and Gubler (Arch. Gén. de Méd., 1860); and, occasionally, paralysis of the vocal cords (independent of laryngeal lesions) from disturbance of the functions of the internal laryngeal nerve; quite exceptionally are all the muscles supplied by the nerve on one or both sides paralysed - the adductors and abductors being usually alone affected - d'Traube (Gesamm.
Beitr., Bd. ii.) was the first to point out this condition; substantive evidence being afterwards adduced by Lübliinsky (Deut. med. Woch., 1895, No. 26), Lünig (Langenbeck's Arch., Bd. xx.), Jourasse (Deut. med. Woch., 1879, 14 & 15), Pel (Virchow-Hirsch, 1879), Boulay and Mendel (Arch. gén. de méd., Dec., 1894), Przedborski (Volkmann's Samml. klin. Virtr., May 1897, No. 182), and Rehn (Deut. Arch. f. klin. Med. Bd. xviii).

Przedborski, in particular, has endeavoured to prove, that paralysis of the vocal cords in typhoid fever is of frequent occurrence — an opinion at variance with that of the other writers enumerated.

B. SENSORY DISTURBANCES;

Still more uncommon are sensory affections of the cranial nerves. Strumpel (loc. cit.) and others, however, have reported trigeminal neuralgia occurring during the course of the fever, and persisting into the convalescence.

AFFECTIONS OF THE SPINAL CORD.

Spinal cord disease is but seldom seen during a typhoid attack, or after it; the typhoid bacillus has very rarely been detected in such cases—a toxic origin is presumed.

Myelitis, of a fatal character, has been recorded by Schiff (Deut. Arch. f. klin. Med., 1900, Bd. 67), the autopsy revealing transverse haemorrhagic inflammation of the level of the fourth and fifth cervical vertebrae; from which, however, cultures of Eberth's bacillus could not be obtained.

Ataxia, upon the authority of Westphal (Arch. f. Psych. u. Nerv., Bd., iii, Heft. 2) and Eichorst and Strumpel (Respective text-books) — in association with tremors of the lower limbs, and in the absence of impairment of strength and sensibility, and with affection of speech of the bulbar variety — constitutes an occasional complication.

Infantile paralysis constitutes another rarity. Its occurrence is vouched for by Benedikt (loc. cit.), and Richardier (These, Paris, 1885); but has been questioned by other clinicians.

Affection of the Peripheral Nerves.

These usually partake of the nature of a neuritis — reference to which has been made in a preceding section.

Disturbances of sensation — in the peripheral nerves, are of less frequent occurrence than motor paralysis.

Cutaneous anaesthesia, already referred to, has been reported by numerous observers — notably by; Griessinger (Loc. cit.), Gubler (Loc. cit.), Duchenne

Anaesthetic areas - seen during the convalescence in adult females - involving large areas of the skin, independent of nerve areas, are probably of hysterical origin.

Neuralgia -

Neuralgias are common, and affect chiefly the heel and toes, occasionally the sole of the foot; they are encountered either towards the end of the defervescence or early in the convalescence. They are, moreover, of a most annoying and stubborn character - the least pressure of the foot upon the ground causing intense agony. Whilst exceptional cases only develop a chronic tendency, they usually disappear of their own accord.

Sciatica is a rare complication; and has been mentioned by Benedikt (Loc. cit.).

Intercostal neuralgia - with or without herpes zoster; occipital neuralgia; and neuralgia of other nerves, are of exceedingly rare occurrence.

The sensory reflexes are diminished usually in severe cases of coma only; in others unaltered. They may, however, be markedly increased - and this persist for weeks or months - when located to the muscles of the abdominal wall, the lower extremities, and soles of the feet - the mere contact of clothing with these parts causing much annoyance to the patient.

THE URINARY SYSTEM.

THE URINE -

As in other febrile disorders, the urine is voided in diminished amount, no matter how much liquid may have been imbibed. Such concentrated urine will be of dark colour, and of high specific gravity - 1030, or more. At the beginning of the defervescence - rarely in nervous persons of both sexes - polyuria is observable, the urine then becoming light in colour, and of lessened specific gravity. Both urea and uric acid are increased during the febrile stage, but diminished during convalescence; the chlorides, on the other hand, exhibiting a reverse tendency.

Febrile albuminuria is quite common (peptonuria but rarely), and in from 10 to 20% of all cases of typhoid fever. Much higher percentages than these have, however, been recorded by; Gubler (Dict. des soi. med., Art. Albuminur.), Weil (Zur Pathol.
und Therap. des Abdominaltyphus, 1883), Murchison (op. cit., p. 488); and observed also at the John Hopkins Hospital (Report, vol. viii., p. 457), where as high as 74% was recorded.

Any quantity of albumin beyond a trace, of small quantity, should be regarded as indicative of a severe attack, and possible impending fatal termination. Febrile albuminuria has been observed as early as the end of the first week - the fastigium being, however, the usual time for its finding; the later its occurrence the more unfavorable the interpretation. No significance can be attached to frequent fluctuations in the amount during the time of its persistence; and the possibility of a return of the albuminuria with a recrudescence or relapse of the fever should be remembered.

Febrile albuminuria seldom persists beyond a fortnight, usually much less; in severe attacks sometimes as long again; or, in certain inexplicable cases, far into the convalescence without renal lesion.

In addition to the crystalline structures observed, and common to the febrile state, the urine of typhoid fever sometimes displays a few leucocytes, epithelial cells, and renal casts; Osler (John Hopkins Hosp. Rep., vol. iii. p. 457) states that the latter were present in 65% of his cases, which showed albuminuria, in 47% of them.

Tissier (Thèse, Paris) has drawn attention to the occasional presence in severe cases, of urobilin due to serious disturbances of the biliary system. Indican, in moderate amount from proteid digestion, is frequently present, but admits of no special interpretation in an ordinary case of typhoid fever, though it is invariably present in peritonitic affections.

Haemoglobinuria is a rare finding; Klemperer (Charîte Ann., 20 Jahr., 1895) reports a case after recovery of a patient from a second attack of the fever.

Haematuria may occur in association with a general haemorrhagic diathesis, and may prove fatal. The blood will be usually found at the autopsy to have originated either from the mucous membrane of the bladder, or from renal infarcts, in which are often found the typhoid bacilli.

Diabetes mellitus is an exceedingly rare complication of typhoid fever.

According to Roque and Weil (Rev. de Méd., 1891) a specific toxine exists in the urine of typhoid fever patients, from which they obtained the Diazoreaction of Ehrlich.

This reaction - whilst at times to be found in pneumonia, tuberculosis, phthisis, scarlatin a, malaria, septic conditions, advanced malignant
disease of diagnostic utility.

Two solutions are required to obtain it ("a" and "b") - "a" consisting of 0.5% of sodium nitrite, and "b" of 2 grams of sulphanilic acid, 150 c.c. of hydrochloric acid, and 1000 c.c. of distilled water. Mix one part of "a" with 50 parts of solution "b" and add an equal volume of urine to it, and shake the test-tube; when a layer of ammonium hydrate will be superimposed, and a ruby ring formed at the line of contact - a brownish ring if the urine be normal; a more reliable change however, is the red-rose-pink hue of the foam.

The reaction appears about the beginning of the second week - sometimes later - and lasts usually until the close of the defervescence. If in a doubtful case the reaction is found between the fifth and the thirteenth day, it is presumptive evidence that the disease is typhoid fever. If, therefore, the reaction is not found in the second week, or the third, of a supposed case of typhoid, it is probable either that the case is of a very mild character, or that the diagnosis is wrong.

Typhoid Bacilluria (or Bacteruria).

This is the term applied to the presence of the typhoid bacilli in the urine, which is observable in 25% of the cases. Richardson (Jour. of Esper. Med., 1895) found them in 9 out of 38 cases, and Smith (Brit. Med. Jour., Feb. 13, 1897) in 3 out of 7. The bacilli do not appear in the urine before fifteenth day, and seldom persist beyond three weeks after defervescence - although Young (John Hopkins Hosp. Rep., vol. viii), and Cushings (John Hopkins Hosp. Bull., Aug. & Sept., 1897) found them there six years afterwards. They may be present in enormous numbers; the urine may indeed be clouded by them - a distinct shimmer on holding up a shaken test-tube filled with such urine to the light, allowing of their recognition without requiring to resort to bacteriologic or microscopical procedure. Gwyn (Phila Med. Jour., Mar. 3, 1900-) estimated the number of bacilli in the urine of one of the patients to be no less than fifty millions per cubic centimetre. Their presence doubtless depends upon a typhoid bacteraemia, by means of which they are brought to the kidney; and their persistence in the urine to their continued growth in the bladder - not upon their escape from the blood; thus, accounting for the presence of pyuria so often seen in such cases.

THE KIDNEYS.

Nephritis.

Acute nephritis may be seen in the
class of cases designated "nephro-typhoid" (Gabler loc. cit.; Degroux and Hanot - Observations d'albumin, dans la fièvre typhoid. Arch. gén. de Méd., 1876; and Kussmaul - Berl. klin. Woch., 1881, 20-21) in which typhoid fever begins with all the symptoms of renal inflammation. The urine in these cases is scanty (or may be retained), and contains albumin, casts, blood, and epithelium. Such patients are very apt to lapse into the typhoid status, with uremic symptoms. Anat (Sur la fièvre typhoid. en forme renale) reported ten deaths out of twelve cases - the usual experience, in spite of Wagner (Deut. Arch. f. klin. Med., Bd. xxv. & xxxviii.) having had five cases of recovery in succession. Acute nephritis may set in at one of three periods; (1) At the onset of the fever - the nephro-typhoid referred to above; (2) early in the fastigium, or in the second week of the fever due to local irritation of the toxine, a serious and frequently fatal condition; and (3) as a sequel, and then usually attended by dropsy.

In comparison to febrile albuminuria, the frequency of nephro-typhoid is small - 1%; the mortality, however, is great, and about one half of the cases die. In five of the twenty-five cases - out of a total of 229 typhoid fevers, at the Johns Hopkins Hospital (Hewelson - J.H. Hos. Rep., vol. v.) death was due to renal perforation.

Renal lymphomata has been reported by Wagner (loc. cit.) and von Recklinghausen (Verhandl. d. phys. - med. Gesel. z. Wurzburg. 1871).

Perinephric abscess has been recorded by several observers, amongst whom may be mentioned; Alrich (Univer. Med. Mag. Feb. 1890) Pearson (Brit. Med. Journ., 1891, i., 861), Adam (Australasian Med. Journ. 1887, ix. 182). Fernet and Papillon (Bull. et Méd. Soc. des Hop., 1897. No.2), and Troissier and Sicard (Ibid); and, as all the cases arose during the convalescence, they were presumably due to typhoid infection.

Pyelitis and Renal Abscess - These may occur after a typhoid attack, the pelves and calices of the kidneys being primarily the seat of membranous exudation, and, later, of erosion and ulceration. The urine in these cases usually contains both blood and pus.

Cystitis; Short of this condition a simple vesical catarrh may occur from catheterizing for the relief of retention. Typhoid cystitis is, however, far from being rare - the bacilli being found in the pus in great abundance, consequent upon their multiplication in the bladder walls, favoured by the difficulty of micturition, or of actual retention.
so common during the fever.

THE GENERATIVE SYSTEM.

A. THE MALE GENITALS.

Orchitis is usually a late complication, or an early sequel; out of the 42 cases collected by Eshner (Phila. Med. Jour., May 21. 1898) it occurred in 29 during the convalescence. These cases usually heal in a fortnight, and without atrophy of the testicle or azoospermia resulting, although 10 of Eshner's cases went on to suppuration — from the pus of 5 of them Eberth's bacillus was cultivated.

Seminal emissions, of abdominal frequency, are often annoying to the patient during his convalescence.

Gangrene of the penis has been recorded in a few instances.

B. THE FEMALE GENITALS.

Menstruation may be induced earlier than expected by the onset of the typhoid attack; and it may be more abundant and prolonged than usual. The possibility of the loss being due to a typhoid abortion should not be lost sight of. The flow, on the other hand, may be suppressed (it usually is), and remain so for two or three periods into the convalescence.

Metrorrhagia, when, occurring, is part of haemorrhagic state, and is of grave omen; as are, also, peruterine haematocoele, and haematometra (Martin — Centralbl. f. Gynak. 1881, No. 26).

Endometritis, and similar diseases, being of anatomic interest chiefly, need not be further considered.

Mastitis, as recorded by Leudel (Clin. Méd., 1881), is a rare complication, and seldom ends in suppuration. A slight enlargement of the breast, however, is by no means uncommon to the febrile stage of the fever.

Abortion and premature labour, are apt to occur from typhoid fever; Liebermeister (Loc. cit.) recording abortion in 15 out of 18 pregnancies, and death in one-third of them; Sacoin (Thèse, Nancy, 1885) premature labour or miscarriage in 150 out of 233 cases, and fatality in 37%. Such accidents may be regarded as unfavourable, and are most common at the beginning of the fastigium, though sometimes occurring as late as the convalescence.

THE ARTICULAR SYSTEM.

Typhoid joint diseases are usually encountered in two varieties; either (1) polyarticular inflammation — rheumatic or pyaemic; or (2) monarticular arthritis. These affections, which are common enough,
have been discussed at length in the anatomic section, need not be further considered.

**THE OSSEOUS SYSTEM.**

Typhoid affection of the bones we have observed elsewhere to be fairly common, especially periostitis, which may even lead on to necrosis. It attacks by preference the tibia and ribs; but sometimes also the os calcis. **Osteomyelitis** has been occasionally observed.

**THE MUSCULAR SYSTEM.**

The muscles may exhibit hyaline degeneration; also abscesses, from primary or secondary infection with Eberth's bacillus, aided by other organisms; they have also been noticed after intestinal perforation.

**ASSOCIATION OF TYPHOID FEVER WITH OTHER CONDITIONS.**

**ACUTE EXANTHEMATA.**

An attack of typhoid fever confers no immunity towards other exanthemata; quite the contrary, as the concurrence of scarlatina and typhoid fever (in any of its stages) is well known - the rashes of the two maladies being present together. This association of the two has been described by Murchison (Trans. Pathol. Soc., 1859, vol.x.; and *Typhoid Disease*, 1867, p. 522), Taupin (Jour. des conn. méd. Chir., 1839), Forget (L'Entérite follicul., Paris, 1840), and many others since then. Scarlet fever, however, usually follows the typhoid attack early in the convalescence.

Taupin (Loc. cit.), and others, have mentioned the association of enterica and German measles; but the probability of the eruption of the latter being either a transient punctate erythema, or due to drugs, makes its reported occurrence doubtful.

Small pox has been known to attack the convalescent typhoid patient (Curschmann - Die Pocken, von Ziemssen's Handb., 2nd Edn., 1875; and Simon - Berl. klin. Woch., 1872, No. 11); and patients vaccinated during the typhoid incubation have been observed to develop the pock in the fastigium. Chicken-pox has, moreover, been known to arise in the course of, or during the convalescence from typhoid fever.
MALARIA.

The association of malarial fevers with typhoid has been observed in the tropics, Japan, China and North America, as well as in other malarial districts - the name "typho-malarial fever" being given to the condition, which in symptoms seems to be a mixture of the two diseases in their typical forms. Many of the cases of so-called typho-malarial fever have been shown, however, by careful blood-examination, to be pure typhoid in which chills, sweats, and intermittent temperature, predominate (Kelsche and Kiener - Malades des pays chauds, Paris, 1889; Scheube - Krankh. der warmen Länder, June, 1896; Lyon - John Hopkins Hosp. Rep., vol. viii; Jaccoud - Clin. med.; and numerous monographs in the literature).

ANTHRAX.

Anthrax has been described by Karlinski (Berl. klin. Woch. 1888) in association with typhoid fever, and confirmed by bacteriologic procedure.

RHEUMATIC FEVER.

Though reported as an associated condition, this may possibly have been pure typhoid with prominent rheumatoid symptoms.

DYSENTRY.

Reports (unsubstantiated by autopsy) received from time to time of the association of dysentery and typhoid must be received with similar reserve, as being probably typhoid inflammation low down the colon or in the rectus.

ASIATIC CHOLERA.

The occurrence of this disease at the same time as typhoid, must be an extremely rare phenomenon, although the one may easily develop in the convalescence of the other.

DIPHTHERIA.

Pseudo-membranous inflammation, as before mentioned, may affect the throat, naso-pharynx, gall-bladder, and genitals. The association of enterica and diphtheria so often reported by the older writers - in the absence of the confirmatory finding of Löffler's bacillus - have, in spite of the insistence of some to the contrary, been merely cases of septic typhoid angina.

ERYSIPLAS.

Typhoid patients may, at any stage of the illness, be attacked by erysiplas, although but rarely. It is commonest in the convalescence, or at other times when bedsores are frequent; Griesinger (Loc. cit.) records 500 cases, with a mortality of 24.
SEPTICAEMIA.
Symptoms indicative of a mixed infection of the typhoid bacillus and pyogenic organism may develop during the course of enterica, and such cases are very frequently fatal. The condition receives the name of "Forme septicide géneralisee" in France (Vincent de l'Inst. Pasteur. 1893, No.2; Chantemesse and Widal - Typhoid Ferv., Traité de Méd., T.i., pp. 293, 294; Vaillard - loc. cit. 1 and Wasserman - Charité-Ann., 1894; T. xix.).

TYPHUS FEVER.
It is but rarely that typhus fever and typhoid are to be found in association.

DIABETES MELLITUS.
The combination of diabetes mellitus with typhoid has been frequently mentioned (Griessinger - Arch. d. Gen. Heilk., 1862. 3. Jahrg.; Baumberger - Würzburger med. Zeit., 1863, Bd. iv.; Gerhardt - Corresp. d. aerztl. Vereins f. Thüringen, 1874, Bd. iii.; Ryba and Plummer - Pra. Viertelj., 1877; Ebstein - Deut. Arch. f. klin. Med., Bd. xxi). Such cases during the typhoid attack usually retain the low temperature peculiar to the emaciated condition; and the glycosuria seems to undergo no diminution beyond a slight amount towards the fatal termination; the usual happening in the vast majority of instances. On the other hand, however, the Serb-and test for acetonuria (closely allied to glycosuria) consisting of the addition of a few drops of the tincture of the perchloride of iron, which produces a Burgundy-red colour with acetone - or rather with aceto-acetic acid - undergoes considerable intensification with the onset of the fever.

MORPHIAISM-
Typhoid fever occurring in the person of one addicted to the misuse of morphia is apt to be of a much more severe kind than usual, and to be accompanied by symptoms of stupor, tremors, subsultus tendinum not infrequently terminating fatally in the typhoid state.

ALCOHOLISM.
Alcoholics bear typhoid very badly, and exhibit the same tendency to low temperature as the foregoing, as well as a similarly high mortality - 34%. The haemorrhagic tendency is very noticeable in drunkards, who suffer from epistaxis, and intestinal bleeding during typhoid; whilst hepatitis, delirium tremens, and cardiac disturbances are apt to complicate the case.

CLINICAL VARIETIES OF TYPHOID FEVER.

1. THE MILD, OR RUDIMENTARY FORM (TYPHUS LEVISSIMUS)
In this form of typhoid the attack is lacking
in severity, the disease exhausting itself in 21 to 28, or in 10 to 12 days. The temperature curve shows a very gradual course, to a moderate height; the characteristic typhoid symptoms are wanting in detail — or even absent. The mildest cases are seen in children; but may assume severity as the illness goes on. Enlargement of the spleen, and a few roseolae, are always in evidence; the fever may take on a remittent character; the case is nearly always unattended by grave complications — which, however, have been observed in exceptional instances. Owing to the indefinite and mild character of the symptoms, the diagnosis is apt to be particularly difficult.

II. THE ABORTIVE FORM.

Cases of this type begin suddenly (very rarely gradually), with shivering, and may end as soon as the tenth day by prompt crisis, or sweating crisis. The pathognomonic signs of the disease appear earlier than usual, and attain their acme of development sooner. Abortive cases, moreover, show a remarkably quick convalescence, but are apt to relapse.

III. THE AMBULATORY FORM (LATENT OR WALKING TYPHOID.)

This variety is usually seen in persons who, from either inclination or necessity, continue their employment, and refuse to lay themselves up until the onset of some serious complication. Some of these cases, again, are discovered by accident in the out-patient service of the hospitals, when presenting themselves for treatment of some vague symptom — in many instances a day or two before the onset of fatal haemorrhage or perforation.

IV. THE AFEBRILE FORM.

This is a rare form of typhoid, and one in which the disease may run its course towards recovery or death without any elevation of temperature, beyond a feeble attempt in the evening; relapses are frequent. This interesting variety has been extensively studied, and reported upon, by Frankzel (Zeit. f. klin., Med., Bd. ii.), Strube (Berl. klin. Woch., 1871. No. 30), and others.

V. THE SUDORAL FORM.

This term has been applied by Jacquod (Loc. cit.) to cases of typhoid — independent of malaria — commencing with sweats, chills, and severe headache, and protracted for a considerable period — the disease being otherwise of a mild form.

VI. SEVERE OR GRAVE FORMS: MALIGNANT OR FULMINANT TYPHOID
THE HYPERPYRETIC VARIETY.

This category includes typhoid cases of the most severe kind; and has been variously subdivided: the adynamic, ataxic, bilious, haemorrhagic, and so forth; combinations of symptoms, however, occur with such frequency as not to admit of comprehensive classification. The severity of the illness may be due to many factors, as grave intestinal lesion, complications, and toxic effects, singly or combined. Hyperpyrexia, systemic intoxication, nervous disorders, and great prostration, are well marked; and a case of the typical kind may at any time pass into the grave variety, from any of the complications. The cerebrospinal, nephro-typhoid, and pneumo-typhoid, all belong to this category.

VII. TYPHOID FEVER OF NON-ENTERIC FORM.

Many of these cases have been already described, when dealing with symptomatology. That typhoid fever may occur without intestinal ulceration is well established - the blood infection failing to manifest its local lesion. The varieties have been described elsewhere, so that little more than mere enumeration is now demanded;

1. Cerebral, Spinal, and Cerebro-Spinal, Varieties - These include the cases, already described, in which the nervous, and mental symptoms predominate.

2. Respiratory Varieties;

   (a) Pneumo-typhoid (Eggert - Inaug. Diss. Erlangen, 1888.)


   (c) Nephro-typhoid

In these cases, Eberth's bacillus has been proved to have produced the local affection, the train of symptoms in connection with which have been described. The disease, however, not manifesting itself by these local symptoms - but with its subsidence becoming characteristically typhoidal - this nomenclature does not appear to the writer as invariably apposite, or necessarily descriptive.
VIII. TYPHOID FEVER IN CHILDREN.

Typhoid fever, as already noted, is by no means uncommon in children; and, generally speaking, in them runs a much milder course than in adults who seem to be less resistant to the toxine. Remarkable recoveries from even severe and protracted attacks, or a peculiar shortening of the febrile stage, have been frequently noted; the mortality may be estimated at 1% or less. The onset, however, seems to be more sudden than in adults, and is frequently free from the usual prodromes. The fastigium, again, may lack certain characteristic features (as diarrhoea - constipation being sometimes troublesome), whilst the roseolas may not be obvious at all, or only to a very slight degree.

With regard to special symptoms, the temperature, compared with that of adults, rises more abruptly, tends to be higher, and to remit, and intermittent, to a greater degree. The headache is seldom absent at the onset, and somnolence is more common than in adults; convulsions, and nervous symptoms more intense; whilst delirium is one of the earliest of all symptoms. Such patients have a tendency to lie on the side; and the spleen may be so much enlarged as to bulge out the hypochondrium. Serious complications (perforation, etc.) are exceptional accidents. Emaciation is usually present to a marked degree; whilst vomiting is often a troublesome, and intractable feature of the early part of the illness. Bed-sores, and noma, in well nursed cases, are of great rarity. The disease seems to be least common before the third year of life, even in children nursed by typhoid mothers.

IX. TYPHOID FEVER IN ELDERLY PERSONS.

The susceptibility to typhoid fever begins to be manifested at the fortieth year, and diminishes from the fiftieth - the disease in old age being of rare occurrence, and is then particularly dangerous. When attacking old persons, whilst it cannot be said to present any regularity of type, is usually less well marked than in younger persons. The temperature seldom attains the same height; but there is, nevertheless, greater danger from certain complications - pneumonia, coma, nephritis, etc. - and the adynamic state. The diagnosis is often particularly difficult owing to the minor degree of spleen enlargement, scantiness of the eruption, prominence of the pulmonary symptoms, atypical temperature, and so forth. The disease, moreover, is apt to run a particularly protracted course; and complications (even the first) are seldom recovered from.
RECRUDESCENCES AND RELAPSES.

By the former we mean the recurrence of the symptoms after a temporary abatement; and by the latter a return of the disease after its apparent disappearance.

RECRUDESCENCE.

Recrudescence, or exacerbation, is manifested by an ascent of the temperature after it has almost declined to the normal, and the symptoms, of the disease vanished. With this, the attack sometimes assumes a greater severity, such conditions being regarded by some as true relapses,—the relapse, as it were, overlapping the attack—and designated "intercurrent relapses."

RELAPSES.

Course of the relapse.

During a relapse the primary symptoms return, and the diagnosis is established by the history of the primary typhoid illness. The temperature, however, is sometimes noticed to ascend more abruptly than in the primary attack; and the rash is frequently absent, owing to its failing to develop by the time the relapse has subsided. The relapse is usually of short duration, but may be protracted longer than the primary seizure—the average duration (Murchison (Op. cit.) is fifteen days. The illness is usually of a much milder character than before; the fever gradually subsides, unless some grave complication (perforation, etc.) occurs. It is important to remember that the occurrence of septic complication may simulate a relapse.

Frequency of Relapse.

Great variety of opinion is expressed in the literature of the disease owing to the doubt entertained as to the interpretation of the term; the character of the epidemic; constitution, &c.

<table>
<thead>
<tr>
<th>Author</th>
<th>Place</th>
<th>Percentage of Relapse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murchison (Loc. cit.)</td>
<td>London.</td>
<td>3.0</td>
</tr>
<tr>
<td>Lindwurm (Aerztl. Intellig., 1873)</td>
<td>Munich</td>
<td>1.4</td>
</tr>
<tr>
<td>Körber (Ibid.)</td>
<td>Munich</td>
<td>1.4</td>
</tr>
<tr>
<td>Bierner (Inaug.Diss., Zurich, 1873)</td>
<td>Zurich</td>
<td>3.3</td>
</tr>
</tbody>
</table>
Predisposing Factors.

Relapses seem to be more common in young persons than in older ones, typhoid fever at both Hamburg and Leipsic exhibiting that tendency, where 13.8% of the 4,687 cases were adults, with 640 relapses - 13.4%, and 13.4% children, 615 cases, with 103 relapses - 16.8%. Females seem to have a greater tendency to relapses than males, as witness the following Hamburg tabulation:

<table>
<thead>
<tr>
<th>Year</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>1886</td>
<td>11.9</td>
<td>16.3</td>
</tr>
<tr>
<td>1887</td>
<td>13.3</td>
<td>15.9</td>
</tr>
</tbody>
</table>

Duration of Relapse;

Repeated relapses appear to be of slighter intensity than the first one, as shown by von Ziemssen's analysis (Loc. cit.) of four cases...
of double relapse;

<table>
<thead>
<tr>
<th>Case</th>
<th>Duration of First Relapse</th>
<th>Duration of Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>21 days</td>
<td>14 days</td>
</tr>
<tr>
<td>Second</td>
<td>21 &quot;</td>
<td>15 &quot;</td>
</tr>
<tr>
<td>Third</td>
<td>11 &quot;</td>
<td>17 &quot;</td>
</tr>
<tr>
<td>Fourth</td>
<td>14 &quot;</td>
<td>23 &quot;</td>
</tr>
</tbody>
</table>

Causes of Relapses;

Exhibition of antipyretic drugs, and the use of the cold bath, seem to have considerable effect in producing a relapse; at least their frequency was especially noticeable during the period of enthusiasm in connection with these remedial measures.

That too early administration of solid food especially in the presence of constipation - can produce a relapse, seems established, by the large number of reported cases; and is supposed by Chiari (Loc. cit.) to be due to the induced sudden exodus of the bacilli from the bile ducts into the intestines.

The character of the epidemic, again, seems to exert an undoubted influence.

Post-mortem findings prove that, with each relapse, fresh intestinal lesions are produced; but nearly always higher up than the original anatomic alteration.

Time of Relapse.

The average period of intermission has been set down by Murchison (Op. cit.) at eleven days; but relapse has been noted as early as two days after the primary attack; or as late as from 26 to 60 days, or even ten weeks.

Repeated Relapses;

A second relapse has been frequently observed; whilst from three to five are clinical curiosities; the severity of the relapses increases in direct proportion to their frequency.

A "spurious relapse" - or pyrexia during the convalescence without symptoms of a true relapse - is due to the influence of some slight irritating condition (as excitement) interfering with the stability of the heat regulating centre.
DIAGNOSIS.

GENERAL DIAGNOSIS. In the case of typhoid fever the most important diagnostic features are; the peculiar temperature curve (slow-step-ladder ascent, and descent - with intermediate maintenance; the roseolae; the Widal reaction; and splenic enlargement.

The Widal reaction is undoubtedly of value; but it must be remembered that failure to obtain it by no means negatives the presence of the disease. The finding of the bacilli in the blood, and dejecta, would be conclusive, of course, but is obviously impracticable except one possesses a bacteriological equipment. The presence of leucocytosis, epistaxis, and early dicrotism of the pulse, are helpful. The fact of the imitation by enterica of other diseases, and the reverse, should not escape attention; so, also, its variation in expending its entire force upon various organs (kidneys, lungs, etc), and thereby lacking its characteristic symptoms - the so-called "paratyphoid". The diagnosis has, therefore, frequently to be of a very guarded nature; and to be eventually attained with certainty only by a careful study of the case, and general history of the illness. A positive diagnosis is, fortunately, in the majority of instances arrived at; in others the exact nature of the disease in question is unknown (though perhaps suspected) and ascertained only by positive findings at the autopsy.

An early diagnosis - in the possible absence of the characteristic symptoms enumerated, and in view of its urgent necessity - must, up to the eight or ninth day at least, rest upon the continuous nature of the pyrexia - without apparent local cause; and the occurrence of typhoid cases in the neighbourhood. It is a golden rule, nevertheless, not to make a positive diagnosis at this time in the absence of all the characteristic symptoms, and a clear history. After the lapse of a few days, the Widal reaction is obtainable, the rose spots appear (usually), and all doubt is removed.

SERUM DIAGNOSIS. The serum diagnosis may prove useful in doubtful cases; and was first suggested by Pfeiffer (Zeit. f. Hyg. u. Inf., Bd. xix.) and Kollé (Ibid. Bd. xxi.), who demonstrated that the serum of animals immunized to typhoid fever both protected other animals against the disease, or during an actual illness of typhoid produced destruction of the bacilli.

We are indebted, however, to Gruber, and Durham...
(Wien. klin. Woch., 1896, Nos. 11 & 12; and Proc. R. Soc., Jan. 3. 1896, vol. 59) for the introduction of the method into practice; and consequent upon their demonstrating that the blood serum, taken during an attack of typhoid fever has a similarly destructive effect upon the bacilli, causing them to aggregate into clumps (in the test-tube), and precipitate, or agglutinate, in the form of a floculent sediment.

The Widal Reaction of Agglutination

Widal (Sem. Med., 1896. No. 33; and Münch. Med., 1897, No. 8) was the first to prove that the agglutinative action of the typhoid serum could be obtained not only after the disease, but during the course of the fever as well. What is known as the "Widal Reaction" consists in the complete loss of the characteristic motility of the typhoid bacilli, and their collection into groups, shrinking, and partly dissolving.

The reaction can usually be obtained upon the seventh day of the disease, sometimes earlier - Johnson and Mc Taggart (Amer. Med.--Surg. Bull., Jan. 10. 1897. p. 12), indeed, obtained it at the fifth day; whilst Widal and Sicara (Ann de l'Inst. Pasteur, May, 1897) vouch for its occurrence as early as the first day of the infection.

In the first week of the disease, the reaction is frequently difficult to demonstrate; in rare instances it may be absent altogether; in some until the convalescence; and in others only during relapses.

The statistics of Stengel and Kneass (Amer. Year. Book of Med. & Surg. 1898) prove the value of the method for diagnosis, and demonstrate the rarity of negative results:

<table>
<thead>
<tr>
<th>Reactions in Typhoid cases</th>
<th>95.5 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No reaction in non-typhoid cases</td>
<td>98.4</td>
</tr>
<tr>
<td>Correct results in</td>
<td>96.5</td>
</tr>
<tr>
<td>Incorrect</td>
<td>3.5</td>
</tr>
<tr>
<td>Total cases</td>
<td>2.392</td>
</tr>
</tbody>
</table>

Or in round numbers:

| In 2,392 typhoid cases positive reaction in 2,283 | 1,387 |
| 1,365 non-typhoid cases positive results in | 22 |

Widal himself obtained positive results in 162 cases of typhoid; and Cabot and Lowell (Boston Med. & Surg. Jour., Feb. 18, 1899) found the results to be negative in 204 cases other than typhoid.

The positive results in the non-typhoid cases were probably due to the presence of the paratyphoid bacillus.
It should be noted that the reaction lacks permanency; as the agglutinating action of the blood diminishes usually in the first weeks of convalescence, and progressively, so that a reaction after a year is quite exceptional; as is, also, the rare instance of the disappearance of the reaction altogether after the eighteenth day of convalescence (Widal and Seyer - Compte-rendu de la Soc. de Biol., Dec. 19, 1896, No. 33), and its persistence for ten years once observed (Musser and Swan - Jour. Amer. Med. Assoc., Aug. 14, 1897.)

The agglutinating substance is present in various secretions extracted from the blood; Widal (Ann de l'Inst. Pasteur. May., 1897, No. 5) found it in, besides the blood, the pericardial, peritoneal, and pleural fluids, the contents of blisters, the bile, semen, milk, aqueous humour, tears; and, somewhat, in the mesenteric glands, spleen, and liver. Catin (Gaz. de Méd. de Paris, Oct. 15, 1896) was able to demonstrate it in the pus of phlegmonous inflammation of typhoid, as well as in the stools; whilst Thiercelin (Compte-rendu de la Soc. de Biol., Dec. 19, 1896, No. 33) found it absent from the sweat, but present in the milk and blood.

The probability of the bacilli being scattered throughout the body in small groups, lends colour to the suggestion of the agglutinosis taking place in the circulation of the typhoid patient; it is only in fresh blood that destruction of the bacilli takes place - Johnson and McTaggart (Montreal Med. Jour., Mar., 1897) state that with blood solutions this phenomenon is frequently witnessed.

The clumped bacilli, if observed for an hour or so, may be seen to break up into granules, which gradually become indistinct and vanish whilst under observation, until practically no trace remains of the clumps which, shortly before, studded the field of the microscope. The change is more liable to occur in cultures some days old than in young cultures, and more likely with attenuated than with virulent cultures.

The agglutinative substance differs from the bactericidal substance; and the agglutination of the bacilli must not be regarded as the beginning of their destruction. Agglutination occurs from contact with immune serum, but bacterial destruction only when there is simultaneous presence of the immune body, the bacteria, and proper complementary bodies. It should, moreover, be remembered that bactericidal powers may be absent from typhoid sera of high agglutinating properties.

The period of most intense infection, and of greatest bactericidal power - according to Jemmel (Centralbl. f. innere Med., Jan. 23, 1897) - show
show most marked agglutination. Widal and Sicard (Compte. rendu de la Soc. de Biol., Mar. 1897) however whilst admitting a relationship between the two, state that they were able to preserve typhoid cultures alive for two months, in strongly agglutinative serum, without destroying their vitality.

A positive reaction was obtained by both Mosse and Dannie (Phila. Pediatric. Soc., 1897), from the blood of both mother and child, as well as the milk of the former, for 33 days after delivery. Pepper and Stengel (Year Book of Med. 1897), Barker (New York Med. Jour., April 16, 1898, vol. 67, No. 16) and Griffith (Amer. Jour. Med. Sci., N.S., Jan.-June, 1897) vol. 113, p. 621), report substantiative cases; whereas Charrier and Apert (Compte-rendu de la Soc. de Biol., de Paris, Jan. 1. 1897), during the third week of the fever, found the agglutinative property of the blood of the foetus whilst it was present in the placental circulation.

The work done, so far, in the Widal reaction goes to prove its great value to the diagnostician; its specific significance is now all but universally admitted; as, apart from the contradictory results from time to time recorded, the observance of the coincident cessation of motion and clumping in the cultures, constitute an almost absolute sign of typhoid fever; the blood in disease akin to typhoid ("Paratyphoid") has been observed to give the reaction; but, being so few, the validity of the test can scarcely be regarded as seriously interfered with. The blood in some cases of chlorais, and icterus (from its taurocholic acid), has been reported, by Köhler (Centralbl. f. Bakter. u. Parasit., May. 22. 1901, xxix, No. 17. p. 633), to have given the agglutinative reaction with the typhoid bacillus; so, also, artificial jaundice produced by ligation of the common bile duct.

The blood of malarial patients, also, sometimes gives a positive reaction, as in the case reported, from Madagascar, by Villiez and Battle (La Presse Méd., 1896, No. 84).

It should, also, be noted that the Widal reaction is not obtainable with the allied members of the typhoid group of bacilli, and that attempts made to make the colon bacillus agglutinate, by the application of typhoid serum, have been attended by signal failure.

Widal found that all human serums when diluted to the extent of 1 to 10, have a slight action upon the colon bacillus; whereas normal serum seldom has any effect upon the bacillus in that dilution; from which it is believed that the constant presence of the bacillus coli in the intestine may occasion the presence of some immune substance in normal blood.
Technique of the Widal Test (With Summary of Practical Points).

Directions for Performing the Test.

A slide for the blood with a central opening, a cantharides plaster, and a glass tube - bulb in its middle - for the serum, having been provided; one part of typhoid blood or serum, with or without a previous dilution with water, is added to one or more parts of a 24-hour bouillon culture of the typhoid bacillus. When the typhoid reaction appears, the bacilli quickly lose their motility and become clumped together in masses. The substances which cause this reaction are absent, or present only to a moderate degree, in the blood of those not suffering from typhoid fever, while after the fifth day the blood of those having typhoid usually contains these agglutinating substances in abundance - in amounts greatly in excess of that found in the blood of those who have not or have not had typhoid infections.

The serum test, as seen from the above statement, is quantitative rather than qualitative. The examination, should, therefore, not only determine the presence or absence of agglutinating substances, but their amount. The results so far obtained indicate that we are safe in drawing the following conclusions;

1st.; That the patient in all probability has typhoid fever, or has had it within one year, in those cases in which the reaction occurs promptly upon the addition of one part of blood serum to nine parts of a bouillon culture of the typhoid bacillus.

2nd.- That if a marked reaction occurs when one part of blood or serum is added to 19 or more parts of a bouillon culture, the probability that the patient has typhoid fever becomes almost a certainty.

The agglutinating substances do not usually appear in the blood in sufficient amount to give the reaction until the fourth day of the disease. From the fourth to the seventh day of the disease specimen of blood or serum from typhoid patients give the reaction in about 70 per cent.; from the eighth to the 14th day in about 80 per cent., and during the 3rd and 4th. weeks in about 90 per cent. of the cases.

In about 5 to 10 per cent. of the cases of typhoid fever the blood does not at any time in the course of the disease give a complete and prompt reaction, when 1 part of blood is added to 1 or more parts of the culture. The absence of the reaction in any individual case does not, therefore, positively
positively exclude the diagnosis of typhoid fever. Either dried blood or the serum obtained from a blister may be sent for examination. The serum can be more accurately tested than the dried blood, and, whenever possible, should be furnished for test.

To prepare Specimens of Blood:
The skin covering the tip of the finger is thoroughly cleansed and then pricked with a clean needle deeply enough to cause several drops of blood to exude. Two large drops are then placed upon the glass slide, one near either end, and allowed to dry without being spread out on the surface of the slide. After they have dried, the slide is placed in the holder, and posted to the laboratory.

To obtain specimens of Serum from Blisters.
The serum is applied to the skin somewhere on the anterior surface of the body, and a small piece of cantharides plaster fixed within the centre. After 10 to 12 hours, the shield is removed and one of the ends of the small glass tube is introduced into the blister. The tube, both ends of which should be open, should be held so that the end inserted is higher than the other, to allow the serum to run into it. After the tube has been nearly filled, it is removed and the ends sealed by holding them for a moment in a spirit, or gas, flame. Care must be observed not to heat the middle portion of the tube, and thus coagulate the serum. The tube so prepared is then placed in a wooden box, and posted to the laboratory.

If the serum is obtained from a patient in articulo mortis, the reaction may be absent.

DIFFERENTIATION OF EBERTH'S BACILLUS FROM THE COLON-BACILLUS.

The main points of distinction may be tabulated as follows:

<table>
<thead>
<tr>
<th>Typhoid Bacillus</th>
<th>Colon Bacillus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bacillus slender, length 2-3 m.m.</td>
<td>1. Bacillus somewhat thicker &amp; shorter.</td>
</tr>
<tr>
<td>2. Flagella numerous (10-20), long, &amp; wavy; active motility.</td>
<td>2. Flagella fewer (8-10); only sluggish movements.</td>
</tr>
<tr>
<td>3. Growth not very rapid, &amp; not very luxuriant.</td>
<td>3. Growth rapid and luxuriant.</td>
</tr>
<tr>
<td>4. Characteristic appearance on various special media (Elsner's etc).</td>
<td>4. The same</td>
</tr>
<tr>
<td>5. An almost characteristic &quot;invisible growth&quot;</td>
<td>5. Brownish pellicle upon potato.</td>
</tr>
</tbody>
</table>
upon fresh acid potato.

6. Acid production in whey not exceeding 3%; sometimes slight in ordinary media, and followed by alkali-production.


8. Causes no evolution of gas in media containing sugar, or in gelatine "shake-cultures."


10. Slow growth on gelatine.

11. Does not split on amygdaline bouillon.

12. Acid reaction in fresh bouillon.

13. Does not grow in bouillon 1/1000 part (by volume) of formalin.

14. Fails to grow on gelatine, unless in the virgin condition.

15. Gives the Widal reaction with the serum of typhoid fever.


DIF F E R E N T I A L D I A G N O S I S.

In order to economise space, this will frequently be dealt with in tabular form.

T Y P H U S F E V E R.

The fact of typhus and typhoid not being distinguished from one another until near the middle of last century, proves the difficulty which even now-a-days sometimes attends the differential diagnosis. This, however, can usually be overcome by noting, in the case of typhoid fever; (1) its gradual onset without severe rigor; (2) the minor intensity of the nervous symptoms if present, and their late development; (3) the lesser intensity of the lumbar pains; (4) the appearance, about the ninth day (3rd to 5th day in typhus) of the eruption, its scantiness, and non-petechial character; (5) the Widal reaction; and (6) the defervescence by lysis.
ACUTE MILIARY TUBERCULOSIS.

In both there occur at times similar features, e.g., pyrexia, delirium, emaciation, bronchial catarrh, headache, meteorism, and, occasionally, a roseolous rash.

Typhoid fever

1. Roseolous eruption in successive crops.
2. Characteristic stools, diarrhoea and abdominal distension.
3. Usually no rigor.
4. Widal reaction present
5. No tubercle bacilli in sputum.
6. Characteristic temperature curve of the continued type.
7. Splenic enlargement.
8. No optic neuritis
10. Cranial nerve affections rare
11. Pulse often dicrotic; slow in proportion to the fever; and respiration only moderately increased.
12. Cough not prominent.
14. No cyanosis.
15. Choroidal tubercles absent.
17. Emaciation of late occurrence.
18. Patient oppressed and apathetic.
19. Co-existence with epidemic or following previous cases of typhoid.
20. Absence of leucocytosis.
21. Evolution of disease characteristic
22. Epistaxis an early symptom.

Acute Miliary Tuberculosis.

1. Eruption exceptional.
2. Stools not characteristic, not necessarily diarrhoea; abdomen retracted.
3. Rigor common
4. Widal reaction absent
5. Tubercle bacilli in sputum.
6. Rapid rise of temperature, with regular or irregular remissions or intermissions.
7. No splenic enlargement
8. Optic neuritis common
9. More rapid prostration
10. Cranial nerve affections common
11. Pulse rapid out of all proportion to the fever and respiration quick and laboured.
12. Distressing cough.
15. Choroidal tubercles present.
17. Early emaciation.
18. Patient alert, and sometimes excited.
19. Family history of tuberculosis, or presence of old focus.
20. Leucocytosis usually present.
22. Epistaxis rare.
23. No characteristic faeces in typical cases.
24. Knee jerk never wanting.
25. Cultures from punctured spleen may show the bacillus.
26. Perforation peritonitis may be present.
27. Tuberculine test always negative.

MALARIAL FEVER.
Possible resemblance; (1) irregular forms of malaria, especially when due to infection by the aestivo-autumnal parasite, and attended by a continued form of temperature; or (2) cases of typhoid partaking of the form of either a remittent or intermittent character.

<table>
<thead>
<tr>
<th>Malarial Fever</th>
<th>Typhoid Fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Intermittent onset.</td>
<td>1. Gradual and progressive onset.</td>
</tr>
<tr>
<td>2. Irregular remissions.</td>
<td>2. Slight, but regular, morning remissions.</td>
</tr>
<tr>
<td>3. Acme of temperature may be attained the first day.</td>
<td>3. Acme of temperature seldom before the 3rd or 4th day.</td>
</tr>
<tr>
<td>4. Headache at onset rare.</td>
<td>4. Headache at onset; constant, and intense</td>
</tr>
<tr>
<td>5. Apathetic countenance, sordes on teeth, and dryness of tongue, not marked.</td>
<td>5. All these well marked, and increasing.</td>
</tr>
<tr>
<td>7. Delirium early and constant.</td>
<td>7. Delirium late, and only in severe cases.</td>
</tr>
<tr>
<td>8. Pulmonary symptoms, if present, are early</td>
<td>8. These of gradual development.</td>
</tr>
<tr>
<td>10. Anaemia early</td>
<td>10. Anaemia absent.</td>
</tr>
<tr>
<td>15. Irregular course.</td>
<td>15. Regular course.</td>
</tr>
<tr>
<td>16. Urine bile-containing; the diazo-reaction rarely present.</td>
<td>16. Bile absent from urine; diazo-reaction present.</td>
</tr>
<tr>
<td>17. Widal reaction absent.</td>
<td>17. Widal reaction present.</td>
</tr>
</tbody>
</table>

**RELAPSING FEVER.**

Early cases of an epidemic of relapsing fever have sometimes been diagnosed as typhoid. It can usually, however, be distinguished by its abrupt onset with rigor and high fever; the epigastric pain; its brief duration; its defervescence by crisis; its relapse at the end of the week; the absence of a roseolous eruption, the step-ladder temperature curve, and Widal reaction of typhoid fever. The presence of the spirillum of Obermeier in the blood should always be looked for, and the nature of the prevailing epidemic investigated.

**MENINGITIS.**

The diagnosis of typhoid fever from this disease should occasion but little difficulty; for, in contrast to the characteristic symptoms of enterica we have photophobia; hypersentiveness to sound; muscular rigidity; exaggerated reflexes; restlessness (apathy in typhoid), vomiting, constipation; early prominence of the nervous symptoms; and a lower and more irregular temperature.

<table>
<thead>
<tr>
<th>Typhoid fever. (Cerebral Form)</th>
<th>Meningitis. (Tuberculous.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Slow onset of characteristic temperature.</td>
<td>1. Sudden pyrexia</td>
</tr>
<tr>
<td>2. Vomiting rare.</td>
<td>2. Vomiting common.</td>
</tr>
<tr>
<td>3. Distended abdomen.</td>
<td>3. Retracted abdomen.</td>
</tr>
<tr>
<td>4. Roseolous eruption.</td>
<td>4. No eruption.</td>
</tr>
<tr>
<td>5. Widal reaction.</td>
<td>5. No Widal reaction.</td>
</tr>
<tr>
<td>6. No signs of tubercle anywhere.</td>
<td>6. Tubercle in lungs, choroid, lymphatic glands, etc.</td>
</tr>
<tr>
<td>7. Drowsiness.</td>
<td>7. Cerebral irritability</td>
</tr>
<tr>
<td>8. Seldom optic neuritis, squint or inequality in the pupils.</td>
<td>8. Frequently optic neuritis, squint, and inequality of pupils.</td>
</tr>
<tr>
<td>9. Spenic enlargement.</td>
<td>9. No splenic enlargement</td>
</tr>
<tr>
<td>11. Unaltered knee jerk.</td>
<td>11. Knee jerk frequently absent, and reappearing at irregular intervals.</td>
</tr>
</tbody>
</table>

CATARRHAL, OR GASTRO-ENTERITIS.

A frequent resemblance of this disease to typhoid exists in the predominence of the abdominal symptoms (more especially in children), headache, and pyrexia; but the temperature chart, splenic enlargement, and the roseolous eruption, as well as the Widal test, in enteric cases, will make the diagnosis apparent.

SALPINGITIS.

The more chronic forms of this disease, on the right side, may simulate typhoid; but there is usually to be obtained a history of vaginitis, abortion, or other etiologic factor; as well as symptoms observable, perhaps, of a localised peritonitis (with fixation of the uterus in the right iliac fossa), but not the classic ones of enteric fever.

PNEUMONIA.

When lobar pneumonia is the initial symptom of typhoid fever, or when the pulmonary inflammation presents the typhoid state, the diagnosis is often impracticable until the appearance of the roseolous eruption, the Widal reaction, and other characteristic features of classic typhoid.

EPIDEMIC INFLUENZA.

This disease has sometimes been known to commence with headache, vomiting, and epistaxis, and to be followed by elevation of the temperature during a period of 3 or 4 weeks. so as to closely resemble typhoid when the latter begins in the same way. A careful study of the case, with application of the following points, will usually suffice to distinguish between them;

Typhoid fever. Influenza

2. Gradual onset. 2. Sudden onset.
4. Marked splenic enlargement. 4. Splenic enlargement, if present, to a minor degree.
5. Characteristic eruption  
6. Widal reaction.  
7. Eberth's Bacillus.  
8. Dicrotic pulse.

APPENDICITIS.  
Mild cases of appendicitis, with accompanying diarrhoea, sometimes bear a strong resemblance to typhoid fever. The following practical points, however, should sooner or later, make the diagnosis evident;—

<table>
<thead>
<tr>
<th>Typhoid fever</th>
<th>Appendicitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gradual onset with constitutional symptoms.</td>
<td>1. More rapid onset with prominent local symptoms.</td>
</tr>
<tr>
<td>2. Fever more continuous.</td>
<td>2. Fever less continuous.</td>
</tr>
<tr>
<td>3. &quot;Pea-soup&quot; stools.</td>
<td>3. Stools not markedly so</td>
</tr>
<tr>
<td>4. Splenic enlargement.</td>
<td>4. No splenic enlargement</td>
</tr>
<tr>
<td>5. Widal test positive.</td>
<td>5. Widal test negative.</td>
</tr>
</tbody>
</table>

SIMPLE CONTINUED FEVERS.

The writer considers it advisable to mention this malady, as certain cases are encountered, and diagnosed as such, in which the only symptoms are moderate pyrexia (continuous for from 5 to 8 days only.), headache, malaise, and possibly enlargement of the spleen — the Widal test giving a positive reaction during the convalescence, thereby giving evidence of its great utility in such obscure cases as these, which are undoubtedly typhoid.

TUBERCULOUS PERITONITIS.

Points of resemblance; — diarrhoea, tympanitis, abdominal tenderness, fever, and emaciation. The following points, which, as in other tables herewith are merely suggestive, should overcome any difficulty in distinguishing;—

<table>
<thead>
<tr>
<th>Typhoid fever</th>
<th>Tuberculous Peritonitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Step-ladder ascent of temperature and similar decline after continuance.</td>
<td>1. Absence of this feature, temperature being often intermittent or remittent.</td>
</tr>
</tbody>
</table>
2. Cutaneous eruption.
3. Splenic enlargement.
4. Widal test positive; tuberculin test negative.
5. Characteristic stools.
6. No ascites.
7. Tenderness in the right iliac fossa.
8. Previous health history of typhoid infection.

CEREBRO-SPIGAL MENINGITIS

Cerebro-spinal meningitis and the cerebral form of typhoid fever may present points of similarity; for, in both, may be observed fever, delirium, somnolence, retraction of the head, tremor, spasm, and prostration. The mode of onset, however, differs in either case; being slow in typhoid, and unaccompanied by vomiting, muscular spasm, or hyperaesthesia. In typhoid, moreover, there is the characteristic mental apathy; the fever is higher, with a typical curve; and the raseolous eruption, and splenic enlargement are characteristic.

ACUTE PULMONARY PTTHISIS

Typhoid fever with extensive bronchitis may be confused with the above disease; but the diagnosis can usually readily be established from points of a practical kind as the following:

Typhoid Fever

1. Roseolous eruption
2. Meteorism
3. Widal test positive
4. No tubercle bacilli in sputum
5. No signs of caseation or of cavity-formation at apices of the lungs
6. Gradual elevation of temperature
7. Epistaxis common
8. No signs of tubercle in the body
9. Prostration moderate

Pulmonary Phthisis

1. No cutaneous eruption
2. No meteorism
3. Widal test negative
4. Tubercle bacilli in sputum
5. Signs of consolidation or of cavity formation at the apices of the lungs
6. Sudden elevation of temperature
7. Epistaxis rare
8. Tuberculous foci may be found in the glands etc.
9. Prostration severe

SIMPLE ULCERATIVE COLITIS.

In both diseases there may be diarrhoea, abdominal distension, melena, and fever; but;

Typhoid fever Ulcerative Colitis.
1. Characteristic temperature curve, and stools. 1. Neither of these characteristic.
2. Splenic enlargement. 2. No splenic enlargement
3. Pain not necessarily in colon. 3. Pain located to colon, sometimes the sigmoid flexura.
4. Cutaneous eruption 4. No cutaneous eruption
5. Widal test positive. 5. Widal test negative
7. No endocardial murmur 7. Frequently an endocardial murmur.

PYAEMIA.

This disease resembles typhoid fever in being attended by delirium, prostration, irregular temperature, and splenic enlargement; but has usually a negative Widal test, a marked leucocytosis, and obvious septic foci. The same remarks apply to Septicaemia - puerperal or otherwise.

URAEMIA.

The more chronic forms of uraemia - sometimes lasting for weeks - may resemble typhoid fever, in the presence of stupor, dry, brown tongue, continuous slight fever, rapid and feeble pulse, and subsultus tendinum; but;

Typhoid Fever Uraemia.
1. Roseolous rash. 1. No cutaneous eruption
2. Widal test positive. 2. Widal test positive.
4. No lesions in arterial system. 4. Lesions in arterial system

ACUTE TRICHINIASIS.

Because of the delirium, dry, brown, tongue, prolonged fever, diarrhoea, and abdominal pain, this disease has sometimes been mistaken for typhoid which, however, can be eliminated by the swelling and tension of the muscles, the oedema of the eyelids, the
dyspnoea, eosinophilia in the blood, and by the finding of the trichina in either the stools or in excised pieces of muscles.

**FEBRILE SYPHILITIS**

Secondary syphilis, and sometimes the tertiary also; have been known to have an indefinite cutaneous eruption, a continued fever, headache, and splenic enlargement, so as to be diagnosed as typhoid. The history of the case, however, with observance of its clinical course, should suffice to make the diagnosis clear.

**INTOXICATIONS.**

"Typhoid" symptoms have been observed to have been produced from the ingestion of diseased meat, vegetables; fish, (Vide account of typhoid due to fried fish in Lancet of July 23, 1904, p. 233), contaminated water and milk, and by the inhalation of putrid gasses, etc. The history of the case is the main thing to be relied upon in dealing with these cases; not omitting, of course, the usual diagnostic procedures enumerated heretofore.

**THE ACUTE EXANTHEMATA—**

These may give rise to occasional difficulty in their initial stages - more especially measles and scarlatina. Time, and the practical points enumerated above, usually unravel the problem.

**ANTHRAX AND ACUTE GLANDERS.**

These being sometimes introduced by symptoms of a typhoid nature, have been known to cause doubt, but the remarks made in the previous section apply here as well.

**PROGNOSIS.**

The prognosis will usually be found to depend upon three conditions, namely (1) the severity of the illness; (2) the circumstances of the patient; and (3) the presence or absence of dangerous complications.

1. **THE SEVERITY OF THE ILLNESS.**

1. **Pyrexia.**

As a rule, the higher the temperature the worse the prognosis. As high as 107°F. have been recovered from, but only when transient; as a temperature of 106°F., prolonged for even two or three days, nearly always means certain death.
a temperature of 105°F., maintained for longer than three days should be looked at askance; and 106°F., or over, as the death-warrant. A prolonged temperature in the fastigium would justify, usually, a grave prognosis; not so, however, in the presence of marked daily remissions (2°F. or so). A sudden or considerable fall, however, with or without a rise, would indicate haemorrhage (not necessarily otherwise manifested), or collapse, and the consequent approach of a fatal termination by profound derangement of the heat-regulating centres. A sudden rise, moreover, would indicate the onset of lobar pneumonia or peritonitis, and should occasion the prognosis to be made with due reserve. A high temperature occurring late in the disease is much more serious than if it occurred about the commencement of the latter; and points usually to complications though often due to retention of urine, so common in typhoid cases. A high temperature attained late in the disease is much more serious than if it occurred about the commencement of the latter; and points usually to complications though often due to retention of urine, so common in typhoid cases. High temperature occurring when the defervescence is due, and maintained, is of serious omen, as is a fall of temperature followed by a rapid rise, both of which can be taken as indices of the severity of the symptoms. Still more so is it a severe illness when the temperature shows a stubborn resistance to antipyretic measures, especially if nervous disorders be simultaneously observed. Hyperpyrexia is always a grave symptom; and due to septicaemia or intoxication in the vast majority of instances.

2. The Circulation.

The condition of the circulation affords a valuable indication of the power of the patient to resist the effects of the temperature; and, so long as the pulse is regular, and in rate not exceeding 110 to 120 per minute, the outlook is favourable. A pulse of 130 per minute is serious; of 140 is fraught with danger; and one of 150 is seldom recovered from. In spite, however, of death having occurred with a pulse of 90, we may regard it as perhaps the most valuable guide we have in arriving at a reliable prognosis. Irregularity or intermittency of the pulse, as well as a persistence of its frequency during the pyrexia, are of obviously unfavourable significance.

3. The Cutaneous eruption.

A copious rash by no means indicates severity in the attack, unless it be repeated, and of longer duration with each crop.

4. Hyperhidrosis

Profuse sweating, so far as prognosis is concerned, need occasion no alarm.
5. **The Spleen.**

Enlargement of the spleen and severity of the illness bear no mutual relationship.

6. **The Stools.**

The more severe the diarrhoea, the greater the reason for suspecting severe ulceration; constipated cases usually do better than those suffering from profusity of the intestinal discharge. Diarrhoea is far more dangerous when appearing late in the disease, as it dries up the tissues; and, by interfering with the alimentary function, produces, or aggravates, the exhaustion. A solid motion passed after a period of diarrhoea points to commencing convalescence.

7. **Tympanitis.**

Tympanitis, being usually one of the features of typhoid fever, is of less grave significance than in other diseases.

8. **Rigors.**

Being usually indicative of a severe complication, rigors must be regarded seriously; otherwise they have no intrinsic danger.

9. **Delirium.**

Delirium is usually of grave omen - and about one-half of the cases so complicated die; if accompanied by coma and stupor fatality is observed in three-fourths of the instances. The mental state is, therefore, a fair index of the severity of the fever - notwithstanding that many fatal cases die with the mind clear to the end.

10. **Tremors.**

If severe, these usually point to deep intestinal ulceration, or to toxaemia; i.e. the grave character of the illness.

11. **Retention of Urine.**

If neglected, this may prove fatal; otherwise, it is not of serious import.

12. **Toxaemia.**

This constitutes one of the main dangers of typhoid fever, and must always be viewed with alarm, death being in the majority of instances inevitable.

11. **THE CIRCUMSTANCES OF THE PATIENT.**

1. **Age.**

Age is one of the most important factors in the prognosis; as the danger from typhoid, after puberty, increases rapidly with advancing years.
After 40 or 50 the typhoid fever is especially liable to fatality; and least so in children, in whom the tendency to both haemorrhage and perforation is reduced to a minimum; and in whom, moreover, the disease seldom assumes a grave character.

The relation of mortality to age is well brought out in the following table copied from the Hamburg statistics of 1886 - 1887 -

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of Cases</th>
<th>Deaths</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 5 years</td>
<td>50</td>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>6 to 10</td>
<td>156</td>
<td>10</td>
<td>6.4</td>
</tr>
<tr>
<td>11 to 14</td>
<td>245</td>
<td>20</td>
<td>8.2</td>
</tr>
<tr>
<td>15 to 20</td>
<td>1100</td>
<td>96</td>
<td>8.7</td>
</tr>
<tr>
<td>21 to 25</td>
<td>992</td>
<td>77</td>
<td>7.7</td>
</tr>
<tr>
<td>26 to 30</td>
<td>602</td>
<td>74</td>
<td>12.3</td>
</tr>
<tr>
<td>31 to 35</td>
<td>269</td>
<td>31</td>
<td>11.5</td>
</tr>
<tr>
<td>36 to 40</td>
<td>127</td>
<td>19</td>
<td>14.9</td>
</tr>
<tr>
<td>41 to 45</td>
<td>81</td>
<td>15</td>
<td>18.5</td>
</tr>
<tr>
<td>46 to 50</td>
<td>26</td>
<td>7</td>
<td>26.9</td>
</tr>
<tr>
<td>51 to 55</td>
<td>13</td>
<td>3</td>
<td>23.0</td>
</tr>
<tr>
<td>56 to 60</td>
<td>8</td>
<td>3</td>
<td>37.3</td>
</tr>
</tbody>
</table>

2. Sex. Typhoid fever seems to be rather more favourable in males than in females; although contrary results in this regard have from time to time been reported.

3. The pregnant, and the Puerperal State. Typhoid fever, more unfavourable in females, is apt to become more so during the puerperal state (including in this the pregnant condition), owing to the many accidents, and the complications which may occur at this time. Murchison (op. cit.) has placed the mortality at 50 per cent.

4. Chronic Alcoholism An Alcoholic history, as we have already noted, greatly adds to the risk of mortality.

5. Obesity Stout persons, especially if troubled with fatty heart or other concomitant, are liable to fatal collapse, delirium or pneumonia.

6. Constitution and General Health of the Patient. Young muscular patients bear typhoid fever best of all; and obviously, especially so if in good health at the time of the attack. Chronic ailments, such as anaemia, chlorosis, morphinism, cardiac and renal and lung affections, mental worries and anxiety, as
well as debilitation and vicious habits, all detract from the favourableness of the prognosis.

7. Idiosyncrasy. This is exhibited in typhoid fever (the same as in other diseases) which some contract more readily, and to a greater severity, than others.

8. Time of Treatment. The earlier this is undertaken the more favorable the prognosis; as also the earlier the patient is removed from unhealthy surroundings to a special hospital.

III. PRESENCE OR ABSENCE OF DANGEROUS COMPlications.

The main points regarding these, having been dealt with at length, require no repetition.

MORTALITY FROM TYPHOID FEVER.

This has been variously stated by different observers as from 5 per cent. on the one hand, to 40 per cent. on the other - the average being roughly - according to my estimate - 12 per cent.; and steadily diminishing with improvements in diagnosis, and therapeutic procedure.

Murchison (Op. cit.) found a mortality of 18.5 per cent. from 1848 to 1862, amongst 2,505 cases treated at the London Fever Hospital; and this may be taken as representative of, and approximating, the mortality at that time elsewhere; the Vienna General Hospital returns, however, (21,189 cases, with 4,708 deaths), being somewhat higher, viz; 22.2 per cent.

Since then, the death rate appears to have steadily declined - the rate at the Leipsic Hospital, from 1850 - 1893 (1,626 cases, with 243 deaths), being 12.7 per cent.; but, prior to that, at the same place, 18.5 per cent. During twelve months of that period (1866-1887), at Hamburg, it was as low as 8.5 per cent (10,923 cases, with 840 deaths), the same being composed of, in 1886 (3,948 cases, with 364 deaths), = 9.2 per cent. and, in 1887 (6,875 cases, with 467 deaths), = 6.9 per cent.

The John Hopkins Hospital Report, for the decade 1889-1899 (1,529 cases, with 63 deaths), shows a mortality of 7.5 per cent.

TIME OF DEATH. Statistics clearly prove that the vast majority of deaths occur about either the latter part of the 2nd., or the end of the 4th week - the latter period in particular - in adults; and between the 10th and the 20th day in children, in whom the disease has been observed to run a much shorter course. Certain complications seem frequently to postpone the fatal issue for a considerably longer
period than that just mentioned.

The following statistics, from the fever hospitals at Leipsic and Hamburg will serve as representative representations:

**At Leipsic:**

<table>
<thead>
<tr>
<th>Death occurred in;</th>
<th>Cases</th>
<th>Percent</th>
</tr>
</thead>
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<td>2.5</td>
</tr>
<tr>
<td>second</td>
<td>37</td>
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<tr>
<td>third</td>
<td>63</td>
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<tr>
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<tr>
<td>eleventh</td>
<td>4</td>
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Note:— Death between the 2nd and the 4th week in 151 cases, i.e., in 62.1 per cent.

**At Hamburg**

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<tr>
<td>11th &amp; 15th</td>
<td>51</td>
<td>14.1</td>
</tr>
<tr>
<td>16th &amp; 20th</td>
<td>68</td>
<td>16.0</td>
</tr>
<tr>
<td>21st &amp; 25th</td>
<td>46</td>
<td>12.4</td>
</tr>
<tr>
<td>26th &amp; 30th</td>
<td>45</td>
<td>12.4</td>
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<tr>
<td>31st &amp; 40th</td>
<td>35</td>
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</tr>
<tr>
<td>41st &amp; 50th</td>
<td>21</td>
<td>5.8</td>
</tr>
<tr>
<td>After the 50th day</td>
<td>28</td>
<td>7.7</td>
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</table>

Note:— Death between the 11th and the 30th day in 210 cases, i.e., in 58 per cent.
TREATMENT

A. PROPHYLAXIS -- DISINFECTION.

Whatever tends to improve the sanitary arrangements of a locality (especially improvements in water supply and drainage) diminishes the prevalence of the disease. From the frequency with which epidemics have been propagated by drinking-water, and milk, these should be boiled, for half an hour, before being used in the patient's house; and by others as a preventive measure. Filtration of the drinking water, by the sanitary authority is much to be commended; such procedure having, at Vienna, reduced the typhoid mortality from 12.5 per 10,000 to 1.1 per 10,000. No water should be used in domestic filters without having been previously boiled.

The excreta should invariably undergo a process of careful disinfection as soon as voided; the most convenient way being to receive them into a vessel containing chloride of lime (in the strength of six ounces to the gallon), carbolic acid - 5%, or a solution of perchloride of mercury (1 : 1000); the latter, however, has the objection of forming insoluble albuminates.

About a pint of chloride of lime should be placed in the receptacle; the dejecta received thereon; another pint added thereafter; the whole thoroughly shaken, and stirred together; and allowed to stand for from two to three hours (six hours in the case of perchloride of mercury) before being emptied into the water-closet. Owing to the presence of the typhoid bacilli in the urine in such abundance, this secretion should receive careful disinfection likewise; and urotropin given by the mouth to disinfect the urinary tract; aided or not by irrigation of the bladder with a 1:1000,000 or a 1 : 50,000 perchloride of mercury solution (Gwyn - Phila. Med. Jour., Jan. 12, 1901).

Both bed-linen, and body-linen should be changed as soon as soiled (in any case daily), the mattress being protected by a mackintosh, and the soiled fabrics received in a sheet dipped in a 5 per cent. solution of carbolic acid; after which they must be boiled, for half an hour; washing with carbolic acid solution will suffice for the purification of the mackintosh.

Every time that the patient has his bowels moved, he should be wiped with a cloth soaked in a solution of corrosive sublimate - 1 : 2,000 or of carbolic acid - 1 : 40; as, also, the receptacle such cloths being immediately burned. The feeding utensils may well be cleansed in hot water after
use, and measures likely to insure ventilation of
them instituted.

ISOLATION OF THE PATIENT.

A sufferer from typhoid should, whenever possible, be isolated in a special hospital; or, failing that, have reserved to him a special apartment, to which none but the medical attendant and nurses have access.

PREVENTION BY INOCULATION.

Much work, of an experimental nature, has been done with a view to discovering a serum treatment of typhoid fever. Not only an antitoxic serum, but cultures of the bacillus have been injected in hope of obtaining a preventative; with results, however, that cannot be considered as entirely satisfactory. The nearest approach to success has been obtained by Professor Wright, late of Netley (Lancet - Jan. 30. 1900) who employed the method of antityphoid inoculation, commencing in July 1896, with bouillon cultures (four weeks old) of virulent typhoid bacilli, containing 1 per cent. of lysol, sterilized at 60°C. Of the culture so prepared, from 0.5 to 0.75 c.c. was injected, the latter dose being the minimum quantity which would be fatal to a 100-drachm guinea-pig. The inoculation is made in the patient's flank; and produced only slight pain and tenderness at the seat of the punctures; as well as some unimportant systemic and febrile disturbance, for 2 or 3 hours; or, at the most, for that number of days. Wright (Loc. cit.) reports having had under observation 11,295 men, of whom 2,835 were thus vaccinated and 8,460 who were not; amongst the latter 2.5 per cent. were attacked by typhoid, but only 0.95 per cent. of the former. The results, however, of prevention of typhoid, by inoculating the soldiers during the late Boer War, are somewhat inconclusive, but seem to point to a relative - not an absolute - protection. During the siege of Ladysmith 10,529 men were not inoculated; of these 1,489 developed typhoid fever - with 329 deaths; but of the 1,705 inoculated, 35 only developed enterica - with 35 deaths.

The statistics of other observers show that inoculation does not protect against an attack of the fever; which, nevertheless, seems to be less frequent, and less severe, amongst those vaccinated against it (History of Typhoid Fever, with Statistics - Pensyl. Med. Jour., Nov. 1900); and to be attended by a somewhat lower mortality.

It is hardly to be expected that we shall ever have an antityphoid vaccine in efficacy equal to that of ordinary calf-lymph for smallpox; owing
to the insidious onset of typhoid, and its non-recognition until the time for vaccination has passed - the cultures requiring several days for the production of immunity.

TREATMENT IN THE COURSE OF THE DISEASE.

GENERAL MEASURES.

Of all these, careful nursing is the most necessary. As soon as the patient is known to have contracted the disease, he must be put to bed and kept there until its course has run. The sickroom (the best one in the house, and, if possible one with a southern aspect) should be cool and ventilated - the windows being kept open night and day; free from appreciable draughts, glaring light, and irritating pictures; and, with everything in it, in a state of perfect cleanliness throughout the entire illness. In view of the risk of bed-sores, the bed should be an iron one, hard, and with a wire woven mattress on which may be placed one of soft hair; care should be taken to keep the sheet, covering the rubber protective, quite smooth - a neglect of which may start a bed-sore. As a special preventive of the latter, the patient's back, heels, and pressure-points, should frequently be examined, and sponged with a mixture of alum in alcohol - the patient meanwhile being turned upon his side to admit of such procedure; general cleanliness of the body is, obviously essential. The necessity for the use of the bed-pan, and the bed-urinal, is, owing to his dorsal decubitus apparent; and the disinfection of these whenever used must on no account be neglected.

The frequency of oral complications demands that particular attention be paid to the hygiene of the mouth - a careful toilet of which should be effected by the nurse washing it out frequently with boracic acid solution, and spraying the throat with same thereafter; frequent moistening of the lips, and tongue, with glycerine and water, is clearly indicated from the parched condition of these parts.

The management of a typhoid case in a private house presents many difficulties - more especially if a trained nurse be unattainable; in which case it will rest with the physician to submit his orders, as to the exhibition of medicines and general procedure, in writing; and to see that only one or two of the relatives are allowed about the patient, and, at the same time, isolated as much as possible from other persons.

D I E T - This constitutes one of the most important problems of a typhoid case. The indications - in
view of the impairment of the digestive functions, and the consequent tendency of the food to accumulate in the intestinal tract, and by acting as an irritant, to increase the fever, the patient's discomfort, and danger - are clearly; (1) to give only such food as can be readily absorbed; and (2) to see that it is of such a kind as will check the waste of tissues occasioned by the febrile process - more especially as regards the destruction of the \textit{proteids}; for which purpose the exhibition of carbohydrates and stimulating food, is demanded, although owing to the marked digestive derangement - difficult of effecting. The disturbance of metabolism in other respects - especially as regards fats and carbohydrates - demands careful attention; both salivary glands, stomach, pancreas, liver, and intestines, having their function markedly disordered - augmented, to no inconsiderable degree, by the long duration of the fever.

The antique idea of a semi-starvation diet in typhoid fever has (thanks to the energetic opposition chiefly of Graves (Clinical Lectures on the practice of Medicine, 2nd. Edn., Dublin 1848), who will long be remembered for his famous statement in this connection "If you should be in doubt as to an epitaph to be placed upon my grave, take this; 'He fed fevers' "), now been abandoned; so that we now endeavour to nourish and sustain the patient from the first, in order to limit (or, if possible, prevent) the destruction of tissue - by means of energy-producing substances, carbohydrates, fats, alcohol, and gelatinous substances.

All articles of diet must, during the course of the fever be given in liquid form only; in small quantities; frequently; and with unfailing regularity: the patient - unless otherwise contra-indicated - being wakened for the purpose. The popular tendency is, however, to overfeed the patient; which is unfortunate, as scarcely any food is digested; during severe attacks; indeed, the digestive functions are almost in abeyance; so that food stuffs of a kind that will remain fluid in the digestive tract are alone admissible. By this means will be avoided increase of the diarrhoea, and the intestinal disturbances. It should be remembered, moreover, that the (too common) exhibition of milk, brandy egg-drinks, gruel, etc., lead to an accumulation in the intestines, with fermentation, and ptomaine-formation; this must always be guarded against. The repugnance of the patient towards food of any kind can usually be overcome by a tactful nurse.

The distressing thirst must be treated with cold water(with or without ice) which, in spite of the popular aversion to it, constitutes the best of all drinks for an ordinary case, and an excellent eliminator of decomposition products as well. No objection can, however, be urged against the well
known natural waters (provided they be free from carbonic acid gas), to which can be added, or not, one or other of the fruit syrups, or better, a mild wine. Cold tea makes a pleasing drink; not so, however, the albuminous drinks (to excess) which possess the disadvantages both of (1) increasing the danger of oral sepsis, and (2) of spoiling the patient's appetite by their insipidity; the fact of their strenuous advocacy by well-known authorities must, nevertheless, be taken into consideration. Some claim to have had satisfactory results with such preparations as albumin-water; which is prepared by straining white of egg through a cloth, and adding an equal part of water—flavouring, if necessary, with vanilla, lemon, or broth.

**Milk**

However desirable milk in itself may be as an article of diet (containing as it does as much solid animal matter—proteids, carbohydrates, salts, and fats—as an ordinary mutton chop (Sir W. Jenner—Lancet, 1879, vol. ii.), it must be remembered that it is in reality a concentrated food—coagulating in the alimentary tract into a solid indigestible curd, so as to constitute a dangerous irritant of the already inflamed mucous membrane. To avoid this as much as possible, it must invariably be diluted with ordinary water (water—including in the term other fluids—may be given up to 80 ounces in the 24 hours; indeed, one-half of the entire food—4 pints—during that period, should be pure water); mineral water (Vichy, Seltzers, Giesshübel, Bilin, Apollinaris, etc) or lime water, so as to be rendered more digestible, nutritious, as well as less susceptible to fermentation. The latter indication can be conviently met by the addition of powder composed of bicarbonate of soda, potash, and magnesia (2 or 3 grains of each).

The nutritious preparation known as "Kefyr" (obtained from the peculiar fermentation of cows' milk by certain fungi containing the bacillus caucasicus) has been much recommended, and affords the patient an agreeable variation.

If in spite of these measures, intestinal discomfort be produced, milk should be discarded altogether. A final attempt may, however, sometimes be made to overcome the objections to it by exhibiting it either (1) in the dilute peptonised form, or (2) after converting it into whey, by boiling each pint of the milk with a tablespoonful of lemon-juice, and straining through muslin, so as to separate as much liquid as possible from the curd (which is then disregarded) — the albuminous substance lost in it being now replaced by beating up an egg with two teaspoonfuls of brandy, and adding 3 or 4 ounces...
of whey and straining.

Milk Preparations.

Home-made broth (from the meat of adult animals only) leaves little to be desired as a nutriment in typhoid cases; due precaution having been taken to strain off any fat globules present. For the sake of convenience, however, any of the ordinary meat extracts (Liebig's, Valentine's, Brand's, Bovinine, etc) may be used instead, provided they be well diluted - the necessity for liquids being so great.

The gelatinous preparations (calves' feet, etc) have much to recommend them; and may be given with ordinary broth, wines, or the fruity syrups.

Meat albumin may, and with pleasing results, be given in the form of fresh beef-juice - prepared according to the formula of the German Pharmacopeia, and containing 6 per cent. of proteid. It may be either added to the soup, or given in the liquid or frozed state - with or without peppermint as a corrective; and, preferably, out of a green glass, owing to the objection of sensitive patients to its bloody appearance.

The much vaunted "haematogen" is still on trial; so, also, "somatose", (meat proteid), "euca-

Stimulants-

Alcohol (which is usually always indicated towards the end of the second, or beginning of the third, week of the fever), in spite of any pyrexia (which it is said to increase) present, and in all cases of exhaustion, should be administered freely without hesitation (the older the patient the greater the necessity, as a rule, for its exhibition), whisky (unless brandy be specially preferred by the patient) being the best form of it in severe cases - sherry or port in mild cases.

The quantity given, at first should be small (2 to 4 ounces in the 24 hours), and be gradually increased as indicated.

The utility of alcohol as a cardiac stimulant is established; and it seems, moreover, to be of
especial value in overcoming the nervous disorders (delirium, coma, etc.) in cases of septic absorption, as well as in combating the distressing symptoms of the typhoid state.

Cases of insomnia, or nocturnal restlessness seem to be especially benefitted by a glass of whisky, more especially convalescents, upon whom its hypnotic effect is remarkable; there are few cases, indeed, which are not benefitted by a glass or two of wine or whisky at any time.

In cases of threatened collapse a dose of one and one-half ounces of whisky, or brandy, every hour, in association with 1/15 grain of strychnine hypodermically every three hours, meets the indication admirably - a more diffusible stimulant - as champagne-being, however, preferable in cases of sudden onset. Nevertheless, other cardiac stimulants (digitalis, ether, camphor (in olive oil) hypodermically, etc.) may be given instead, if more convenient, or specially indicated.

Rectal Alimentation. This form of treatment is specially indicated in persons who, owing to the persistent vomiting, or gastric irritability, are unable to partake of nourishment in the ordinary way, and are, in consequence, threatened by death from starvation. A convenient procedure is that of the exhibition, per rectum, of 3 to 4 ounces of peptonized milk, with ½ ounce of meat-juice, and a small quantity of egg-albumin - every four hours; the return to ordinary diet in such cases should be very gradual.

HYDROTHERAPY. It is now generally agreed that the best method of treating the pyrexia of typhoid is by means of the cold bath, notwithstanding that the objectors to its exhibition are numerous. The method is an old one, originating with Currie of London - but with little or no acceptance - over 100 years ago; and reintroduced, and popularised, in more recent times, by Brand, of Stetin, and his followers (Cong. f. innere Med., Wiesbaden, 1882).

The difficulty of obtaining suitable tubs and facilities for using them, causes the use of the cold bath to be withheld, to a great extent, in private families.

On account of its great efficacy, the procedure should be attempted whenever possible, as the following results, moreover, may be expected from its judicious employment:

(1) A prompt reduction of the body-temperature and maintenance of the same after a day or two of bathing.

(2) Relief of the nervous discomforts - delirium, muscular twitchings, insomnia, etc.
(3) Stimulation and strengthening of the heart, with avoidance of sudden, or gradual, failure of its action, as well as prevention of hypostatic pulmonary congestion, and venous thrombosis.

(4) Increased respiratory efforts, and, in most cases, the consequent escape from pulmonary complications, more especially from bronchitis and pneumonia.

(5) Increase of the renal function, with elimination of the typho-toxines.

(6) Avoidance - to a great extent - of bedsores, owing to the induced cleanliness of the skin.

(7) A shorter illness, and more speedy convalescence.

According to the published European results, by the method of hydrotherapy the mortality from typhoid fever has been reduced (in cases upon whom practised) to 0.5 per cent. and, in no instance, has death occurred when it has been instituted before the fifth day of the illness. In America, however, the mortality has been reported as somewhat greater, averaging 7.5 per cent., with a minimum of 4.4 per cent.

Procedure-

(1) Ziemssen's Method (the gradually cooled Bath)

The bath-tub - containing about 30 gallons of water - is brought to the patient's bed-side; his night dress removed, and towel placed round his loins; after which he is carefully lowered into the bath (by means of a sheet at each corner by a nurse) and held there - with his head resting upon a rubber air-cushion - for from 5 to 8 minutes at first, later for 15 minutes, or according to the severity of the case; and his skin submitted to vigorous friction in order to avoid the discomforts, and depression of the peripheral circulation, and the chilliness. His head and face are now bathed with cold water (especially if suffering from nervous disorders) either from a basin in the ordinary way, or by means of douching from a height of six inches or so - the ears being protected by closure with cotton wool. Should the bath prove very obnoxious to the patient (or he be observed to be shivering), a glass of whisky may be administered forthwith, or, better, removal back to bed be at once effected. Very young, or elderly, persons should have the bath at a temperature not lower than 85°F., 90°F.; after repeated bathing, however, a temperature of as low as 70°F. - but no less - may be utilized.

(2) Brand's Method (the cold plunge)

This method has now almost superceded the foregoing; and consists in lifting the patient at
once into the bath at a temperature of 70°F, and keeping him there for 15 minutes; after which he is returned to bed (the same being protected by a mackintosh and blanket) gradually dried, and wrapped in a blanket after withdrawal of the protective. His circulation is restored, if necessary, by vigorous massage (aided, or not, by a glass of whisky); but the blueness and shivering which sometimes follow the bath are not, however, serious features. The effect of the bath is best ascertained from the rectal temperature (taken immediately after the plunge, and again of an hour later if the patient be not asleep), which will be found to be two or three degrees lower than before immersion; failing which, the bath may be repeated, and prolonged, if necessary, to twenty minutes. In typical cases hydrotherapy is demanded only about three times in the 24 hours; but, in severe cases, it may be necessary to have recourse to it as often as every three hours - oftener than that is dangerous. The bath should be used when the temperature, in the rectus reaches 102.2°F., and continued from time to time until the evening temperature remains below 101°F.; when specially demanded for the relief of nervous symptoms, the element of temperature, as an indication, may be disregarded altogether.

**Contra-indications.**

The bath should not be used in cases of:-

1. Intestinal haemorrhage - owing to the danger occasioned by disturbing the patient's position.
2. Peritonitis - or perforation - in which absolute rest is essential at all times.
3. Extreme cardiac weakness - owing to the probability of collapse (more especially in elderly persons) from the excitement, or dread, of the procedure.
4. Advanced illnesses - after the third week - owing to the risk of sudden collapse.

**Substitutes for the cold Bath.**

Owing to either dislike of the procedure, or inefficiency of the means at disposal, these are gradually coming into vogue;-

1. Cold sponging, but inferior, substitute for the cold bath; and for it water - with or without admixture with vinegar or spirits - of the same temperature as the air of the sick-room is employed; each part of the patient's body being bathed and
dried in succession; and the process (in the absence of contra-indications) continued until a reduction of temperature by 1° to 2° F. is obtained. The effect can be greatly enhanced by the use of the ice-cap - continuously, or at intervals.

(2) Cold Pack - The cold pack forms an excellent substitute for the plunge; especially in cases of children, in whom the reaction to the bath is apt to be unsatisfactory. For it, the patient, is placed upon a blanket or sheet wrung out in cold water (70° F. to 80° F.) - or the sheet may be made wet, and kept so, by sprinkling from a water-pot - and kept there from ½ to 1 hour; with the result that the temperature usually falls two degrees or more; it may be repeated every 3 or 4 hours if necessary.

(3) Ice-water Enemata - These are employed in desperate cases in whom the plunge-bath is contra-indicated; and, when, carefully used, are said to be quite as effective.

(4) Leiter's Coils - These well known appliances may be applied to the chest, abdomen, and head.

(5) Guaiacol - Guaiacol, to the amount of 10 to 30 minims, rubbed upon the skin has been known to induce rigors, hyperpyrexia, and serious symptoms; which effect can be avoided by using only sufficient to lower the temperature to 100° F.; its potency as an external antipyretic is undoubted.

(6) Air-cooling - This consists in cooling the air around the patient's body by covering him with a cradle (to keep off the bed-clothes) - small zinc buckets, filled with ice, being at the same time suspended from the cross-bars of the apparatus.

The Cold Bath as a Routine Treatment.

In spite of the cold bath being now so widely recommended and utilized, its use by way of routine is to be deprecated; each case requiring to be specially selected on its own merits.

Smith, of New York (Med. News. Oct. 20, 1900), very properly, contends that anything that puts such a strain upon the patient as to require free stimulation, in consequence, had better not be used indiscriminately; and that a sponge bath, of 1/3 alcohol and 2/3 cold water, will reduce the temperature sufficiently without weakening the patient.

Hare (System of Therapeut., 2nd Edn. vol. ii p. 40) states that he is an advocate of the immersion or plunge bath, in suitable cases, and of the modified bath in all cases of typhoid fever; and is
opposed most strongly to the indiscriminate use upon every patient of the cold plunge; contending, moreover, that it produces 1; (1) an unnecessary expenditure of the patient's strength; (2) an increased tendency to haemorrhage; (3) more frequent relapses; (4) a longer duration of the disease; and (5) very commonly albuminuria.

Curschmann (Loc. cit), likewise, strongly deprecates the routine use of the cold bath, though recommending lukewarm ones. He insists that cases of severe onset, with symptoms of intense persistent intoxication, should from the outset be subjected to the bath treatment; but not so the mild, or moderately severe cases, which may require only the ordinary medical treatment. In all cases he gives one or two cool, or tepid, spongings, by way of refreshment, and to control any nervous symptoms present; but strictly forbids every form of bath treatment; (1) upon the appearance of the first, or slightest, sign of either intestinal hemorrhage or peritonitis irritation; (2) in cases of cardiac weakness; (3) in arterio-sclerosis; (4) pleuritic effusions; (5) phlebitis; (6) severe laryngeal lesions; (7) at the extremes of life; (8) in anaemia; (9) chlorosis; (10) obesity; (11) alcoholism — in all of which the danger of bed-sores being induced must be borne in mind.

ANTIPYRETIC DRUGS.

These, in spite of their endorsement and powerful temperature-reducing effect, have now come to play a minor role in the treatment of typhoid fever. Their soothing effect upon the nervous system, and undoubted antiseptic action, moreover, accounts for a good deal of their indiscriminate exhibition now-a-days. Even the most reliable of them possess the serious defect of producing a sudden or gradual cardiac depression — itself a danger signal of the disease. Their routine use is, therefore, much to be deprecated; and the time may come when they will be discarded altogether.

Phenacetin— A small dose of phenacetin — 2 grains, with perhaps 1 grain of the hydrobromate of quinine — is one of the safest antipyretics. It may be given every hour until the temperature is reduced to the desired degree; and the good effect thereafter maintained by its exhibition every three hours.

Quinine— This may be given in doses of 15 grains — even before the rise of temperature occurs — and repeated every hour or so. The usual drawbacks (noises in the head etc.) are either not felt, or not complained of, owing to the semi-unconsciousness of the patient.

Antipyrine— The temperature-reducing effect of
antipyrine makes its exhibition desirable in typhoid, but for the cardiac weakness and vomiting which it so often produces, unless carefully administered; and then, better by way of anticipation - as with quinine - before the exacerbation of temperature occurs; and in doses of 2 to 5 grains, in two equal parts, with an hour's interval between. Should cardiac weakness exist, or be feared, the dose may be reduced to a very small one; or, if causing gastric irritability, it may be given hypodermically.

Lactophenin- According to von Jaksch (Prag. med. Woch., 1894. No. ii), this well known antipyretic, in typical cases, is productive of the usual benefits without unpleasant after-effects; and with a particularly soothing effect upon the nervous system; it may be given, in doses of 8 to 15 grains, in starch capsules.

Salicylic Acid, and Sodium Salicylate- These remedies seem to be devoid of any special action, in typhoid cases, such as would call for their special exhibition; they have, moreover, been known to produce symptoms of heart failure.

Antifebrine- This coal-tar preparation, though quite as potent as antipyrine - if not more so, must only be given, it at all, in very small doses; as it is frequently associated with serious secondary effects (chilliness, cyanosis, and irregular and enfeebled cardiac action); in certain cases, its exhibition has been attended by speedy collapse.

Other antipyretics, being either still on trial, or distrusted, are not to be recommended.

INTESTINAL ANTISEPTICS; These are frequently used for the relief of tympanitis; as they fail to destroy either the bacilli or their toxines, too much must not, however, be expected from their exhibition.

Salol. This drug, forming within the intestine carbolic and salicylic acid, is, perhaps, most to be recommended (in doses of 2 to 3 grains) in capsules, every three hours; its general effect, moreover, can be greatly enhanced by combination with 1 to 3 grains of quinine.

Chlorine- Of all disinfecting agents, chlorine seems to be the most efficacious - its power of allaying the abdominal symptoms (as pointed out by Wilcox - Med. News. Feb. ii. 1899) being most marked. The solution of the gas is prepared as follows: Place 30 grains of powdered potassium chlorate into a 12-ounce bottle, and pour on it 60 minims of strong HCl, when chlorine gas will at once be liberated. Fit a cork into the mouth of the bottle and keep it closed until it has become filled with greenish-yellow gas, to hasten which the bottle must either be shaken or allowed to stand in hot water. Then
pour water into the bottle, little by little, closing the bottle, and well shaking, at each addition, until the bottle is filled; remembering that if the bottle be too rapidly filled with water, the chlorine will be driven out of it by the water instead of being dissolved in it. Of the solution, to an adult, may be given ½ to 1 ounce for a dose; and its effect can be enhanced considerably by the addition of quinine, and its taste disguised by syrup of lemons. The first effect of the exhibition of this solution will be an immediate cleaning of the tongue; followed by disappearance of the offensiveness of the evacuations, an odour of chlorine being detected in the stools. Part of it being absorbed into the blood, a general disinfectant action is obtained.

Intestinal Lavage Flushing of the intestines, by means of a rectal tube, constitutes a valuable means of overcoming tympanitis, the dangers attending the procedure, as described in the text-books, being, of course borne in mind.

Carbolic Acid—Pure carbolic acid has been much used; and is best given in combination with chloroform, when, according to Quill (Brit. Med. Jour., April, 28, 1894), it may be expected to give very satisfactory results, especially if given in full doses at short intervals.

Turpentine—This agent (in association with alcohol) is especially indicated to patients who have lapsed into the typhoid state— with muttering delirium, tympanitis, and so forth—which it usually relieves. It may be given in capsules every three hours; or in mixture, with oil of cloves, glycerine, and syrup.

Guaiacol Carbonate—In doses of 15 to 30 grains, twice daily, this drug has been recommended, by Holscher (Loc. cit.), consequent upon his experience of it in 60 cases without a death.

Sulphurous Acid—This remedy, in doses of 3 to 20 minims every 4 hours, is believed by many to be a reliable internal antiseptic.

Naphthal Preparation—
(1) Beta-Naphthol is sometimes given, in powder with salicylate of bismuth, on account of its powerful antiseptic effect; which, owing to its insolubility, is never exerted until the small intestine is reached.

(2) Alpha-Naphthol, however, may be used if preferred; as it is three times less toxic; and 1 part to 10,000 will prevent the development of Eberth's bacillus; it is given in the same way as the foregoing.

(3) Salicylate of Naphthol (Betol or Naph-)

(4) Benzoate of B.-Naphthol (Benzo-Naphthol) as well as Magnesium benzoate, have all been re-
recommended by their introducers.

Calomel— This drug, being directly bactericidal (as well as indirectly antiseptic by ridding the intestine of decomposing material and putrefactive organisms) has been much vaunted, more especially by Liebermeister (Loc. cit.), who gives it (in doses of 8 grains three times a day for 24 hours) to every case before the ninth day of the fever; with the result that he found it to shorten the duration and intensity of the disease. The use of aperients, however, must be restricted to the first few days of the attack, and only to relieve constipation, or to secure an initial cleansing; otherwise, in the presence of deep ulceration, the aperient may kill the patient. A smaller dose than that recommended by Liebermeister is, in all cases, advisable.

Perchloride of Mercury— This can be given with advantage (½ to 1 dram of the officinal solution, with or without 1 or 2 grains of quinine) when the stools are offensive, the abdomen distended, and the fever high.

Chloroform Water— in the strength of 1:150, this, owing to the germicidal action of the chloroform, may be given with great advantage.

Hydrogen Peroxide— In the strength of 27 minim's to the ounce of water, hydrogen peroxide has been vaunted as an intestinal germicide in typhoid fever by Carter, of Liverpool (Lancet, July 2, 1904), who testifies from experience (in connection with Dimond, of the Royal Southern Hospital, Liverpool) as to its sterilizing power upon the bacilla.

Acetone— This, in doses of 1.150—2,500 c.c.s. of a 24-hour old solution daily, has been strongly recommended by Wasdin (Therap. Gaz., May 15, 1902) in typhoid — the bowels, prior to its exhibition, having been opened by calomel.

Potassium Iodine— This has been recommended on account of its iodine; and has been said to have a marked efficacy in reducing the temperature, and allaying the general discomforts; the sodium preparation may be used if cardiac weakness be observed.

Other Antiseptics, as creosote, oil of eucalyptus, camphor, and sulphide of carbon water, may be used if specially preferred or indicated.

SERUM THERAPY;--

Attempts to treat typhoid fever with cultures of serum have been suggested by the brilliant results obtained by similar procedure in diphtheria, and other affections; but, so far, a therapeutic effect with regard to typhoid has not yet been established; although, in some cases favourable results appeared to have followed the inoculation of typhoid serum from man and animals.


TREATMENT OF SYMPTOMS AND COMPLICATIONS.

HEADACHE;

This troublesome disorder usually yields to absolute rest, quiet, and cold applications to the head; failing which, one of the analgesics may be resorted to - the best of all being, perhaps, sodium bromide, in doses of 10 to 15 grains; with either 2 or 3 minims of tincture of opium, or a few grains of phenacetin, in severe cases.

INSOMNIA;

Under no circumstances must insomnia be allowed to go on untreated, as it is apt to merge into the typhoid state. The remedies mentioned under headache usually relieve it; but, if not, 1/16 to 1/4 grain of morphia hypodermically affords prompt relief, and without any of the usual drawbacks of the drug. Sulphonial, trional, chloralamid, codeine, and drugs of that class, may be trusted if morphia be contra-indicated; in view of the cardiac weakness, chloral had better be withheld.

DELIRIUM;

Cases treated judicially with the cold bath seldom present this distressing feature; but, if present, it can usually be relieved with alcohol (or 10 minims of ether hypodermically) at intervals of 1 or 2 hours. Nerve stimulants - musk, valerian, hyoscyamus, etc. - are often of surprising efficacy in allaying it.

VOMITING;

If occurring during the febrile period, it can usually be dispelled by calomel - to which sodium carbonate can, with advantage, be added; if during the fastigium, the diet must be reduced, the food peptonized, and diluted with lime water, and dietetic errors rectified. Being often due to the patient's aversion to milk, this must be discarded; ice given to suck, and champagne, in small doses, exhibited
at short intervals. In the worst cases, rectal alimentation must be resorted to.

**DIARRHOEA;**

This claims special attention more often than any other condition and always, and only, when the stools exceed four in the twenty four hours. Regulation of the diet, as a rule, suffices, for its relief, when due to errors of that kind; but, when recognised as due to intestinal lesions, insoluble intestinal antiseptics must be administered forthwith. The efficacy of these can be much enhanced by astringents which, nevertheless may be given separately; the most reliable are bismuth, Dover's powder, tannin, opium, and acetate of lead. Late in the disease, when the ulcers are fully formed, opium is the best remedy for the diarrhoea, as it both checks the peristaltic action producing it, and protects the peritoneum from inflammatory affection. It may be given in enema with tannin or starch - alternated with some antiseptic - twice daily.

**CONSTIPATION;**

This frequent, and early, symptom, usually promptly yields to a simple enema (better given with an antiseptic such as sanitas), or to a dose of 3 grains of calomel. When existing during the third week, mild saline laxatives are to be preferred, of which salicylate of magnesium (50 to 100 grains) is most to be recommended. During the convalescence, a pill of aloes and belladona meets the indication admirably.

**TYMPANITIS;**

This may usually be remedied by one of the following methods; (1) Regulation of diet - especially by a change from milk to soups or albumin-water; (2) hot fomentations with turpentine, or belladona; (3) oil of turpentine by mouth or rectum; (4) rectal lavage - the risk of urinary retention sometimes attendant upon such procedure being remembered, or (5) irrigation of the colon with a normal salt solution.

**INTESTINAL HAEMORRHAGES;**

The first indication for the relief of this dangerous complication - besides restriction of the diet - is absolute rest; even to the extent of allowing the defecations to be passed into the drawsheet. Ice-bags should be applied to the loins; and ice given freely by the mouth. Opium with acetate of lead usually gives relief; but, in severe
cases, hourly hypodermic injections of ergotine must be tried, and seldom fail to arrest the bleeding. In this connection it may be remarked that adrenalin chloride, and the suprarenal extract have proved their efficacy to a marked degree. In very severe bleedings with threatened collapse, saline infusion (which both restores the vascular equilibrium, by compensating for the liquid lost, and acts as a haemostatic) may be tried, by any of the methods of hypodermoclysis or enteroclysis.

PERFORATION;

Enough has been said about this serious complication to show that it calls for immediate laparotomy (with general, or local anaesthesia with cocaine - Cushing (Annals of Surgery, May, 1901, p. 544), the peritoneum being flushed with sterilized water after closure of the opening, or resection of the lacerated part. The earlier the operation is done the better; if too late, the bowel must be kept at rest by large doses of opium (Wickulicz - Volkmann's Samml. klin. Vortr., No. 262; Lücke - Deut. Zeit. f. Chir., 1887, Bd. xxw; and Gesselewitsch and Wannach - Nitth. aus dem Grenzgebeitend. d. Med. u. Chir., Bd. ii., Hef. 1. u. 2, S. 32).

PERITONITIS;

When occurring apart from perforation, peritonitis is best treated by opium, and saline laxatives; but, even then, the advisability of an exploratory laparotomy should be seriously considered.

PNEUMONIA;

Pneumonia, of any variety, should be treated on general principles, and as if no typhoid present; and hypostatic congestion by change of the patient's position, and administration of cardiac stimulants.

BRONCHITIS

The same remarks apply here also

LARYNGITIS;

Counter irritation by liniments may be curative; failing which, a blister on either side, behind the jaw, may suffice. Oedema of the larynx, however, requires scarification, and steam inhalations; but, in cases of impending suffocation, prompt tracheotomy is the only resort.

BED-SORES;

Should the preventive measures already des-
described have proved futile, they may be bathed with some antiseptic solution, and dusted with zinc-oxide, starch, calomel, bismuth, or aristol each day. Ointments - as zinc, lead, Peruvian balsam (1 : 30) - constitute valuable in cases of bed-sores; they can be held in position by strips of diachylon plaster.

THROMBOSIS OF THE FEMORAL VEIN;

This is best treated by elevation of the limb, and immobilization; an ointment of ichthylol (12%), Lanolin, and belladonna ointment, in equal parts, being applied three times daily. The use of a tepid water bed, air, or water, cushion, will prove grateful in this as well as the foregoing complication.

CHOLECYSTITIS;

The majority of cases of this condition require surgical treatment; if ending in perforation, an operation must immediately be performed; and it seems to be a wise procedure by way of anticipation - Cushing's method of local anaesthesia will be sufficient to cover the pain of the incisions.

EAR DISEASE;

Patients being semi-conscious, do not often complain of this, however advanced; hence the necessity for frequent examination, and prompt perforation of the drum, if the middle ear be inflamed.

KIDNEY AFFECTIONS;

The urine should be frequently examined; and, when kidney disease be detected, antipyretics should be at once withheld. Bacilluria usually disappears on exhibition of urotropine in 10 grains doses.

TREATMENT OF RECRUDESCENCES AND RELAPSES.

This should be undertaken on the same lines as the primary attack; due regard being paid, however, to the weakened state of the patient, and less vigorous measures utilized. Quinine, care¬fully administered, is said to have some effect in either preventing them, or in shortening their duration, and allaying their severity.

TREATMENT OF THE CONVALESCENCE.

The main element of success during the conval—

escence
lies in proper attention to the patient's diet; his craving for solid food in large quantities (a common feature) being resisted firmly, and entirely negatived until the temperature has remained normal for at least twelve days.

Return to solid food must be very gradual, and it must be administered in an easily assimilable form - due attention being, of course, paid to the regulation of the bowels.

The patient should be kept in bed for a fortnight (as in spite of the temperature being normal, the ulcers may not be healed before that), and only very gentle exercise be indulged in at first.

In order to avoid a recrudescence, all mental excitement must be carefully avoided.

Any diarrhoea present may be controlled by albuminous or starchy diet, zinc. oxide, and astringent enemata - the patient being meanwhile kept in bed.

Constipation, on the other hand, may be troublesome, and is relieved by the usual enemata.

Tonics prove useful throughout the typhoid convalescence; and should assume the form of the ammonio-citrate of iron, or of iron and quinine and strychnine, combined with a simple bitter infusion.

Any lung weakness may be dealt with by cod-liver oil, or creosote.

A change of air is always beneficial, and indicated.
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