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By

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On

T Y P H O I D F E V E R

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T Y P H O I D F E V E R.

DEFINITION.

Typhoid fever is an infectious and acute disease due to the bacillus typhosus,usually lasting between three and four weeks,and associated with peculiar and constant lesions of the solitary and agminate glands of the ileum,and with enlargement of the spleen and mesenteric glands. Its invasion is,as a rule,gradual,and often very insidious. Sometimes the only symptoms present in the beginning are a feeling of lassitude,sometimes gastric derangement,and a slight elevation of temperature; at other times there are slight rigors or chilly sensations,headache,epistaxis,diarrhoea,and pain in the abdomen. The principal symptoms of the fully formed disease are a febrile movement,possessing certain characters; headache,passing into delirium and stupor;diarrhoea,associated with ochre-yellow stools; pain and gurgling in the right iliac fossa; a red and furred tongue, which later becomes dry,brown,and fissured; a frequent pulse;and eruption of rose-coloured spots,occurring about the seventh or eighth day,slightly elevated above the surface,disappearing under pressure, and coming out in successive crops,each spot lasting about three days;prostration - not marked in the beginning,but rapidly increasing; and occasionally deafness,sweatings,and intestinal haemorrhage. When recovery takes place,the convalescence is usually tedious,and may sometimes be protracted by the occurrence of one or more relapses. The rapidity with which the symptoms are manifested,and the degree to which they are developed vary in different cases of the disease.

SYNONYMS.

A glance at the literature of the past will show how many and varied are the names that have been,for one reason or another,applied to typhoid fever. Only a very few are now,however,retained - the remainder having been discarded. The following are some examples: Febris Mesenterica (Baglivi,1696); Nervous Fever (Gilchrist,1734); Slow Nervous Fever (Huxham,1739); Slow Fever (Strother,1729); Febricula,or Little Fver (1740); Pyretus Hemitritaeus (? Hippocrates); Febris Semitertiana (? Galen); Nervenfieber,Fièvre Nerveuse, Low Fever, Febris Putrida (Riverius,1623);typhus Nervosus (Sauvages, 1760); Miliary Fever (Pringle and De Haen,1760); Febris Lenta (Forestus,1591); Typhus Mitior(1769); Febris Gastrica (Ballonius,1640)Fièvre Méningo-Gastrique (Pinel,1798); Bilious Fever (Pringle,1750); Febris Intestinalis vel Mesenterica (Riedel,1848); Synochus (1769),Remittent Fever (Sutton,1806),Common Continued Fever (Armstrong,1816),Gastro-Enterite (1816); Enteritic Fever (Mills,1813); Entero-Mesenteric Fever (Abercrombie,1820); Febris Mesaraica (Wendt,1822); Typhus Fever of New England (Bartlett,1824); Unterleibstyphus (Autenrieth,1822); Fever with Affection of the Abdomen (Allison,1827); Fever with Ulceration of the Intestines (Bright,1829); Abdominal and Darm Typhus (1820); Typhoid Fever (Louis,1829); Dothientérie,corrected later to Dothienentérite (Bretonneau,1826); Infantile Remittent Fever (1836); Enterite Septicémique (1841); Mucous Fever (1846); Enteric Fever (Ritchie,1846); Typhus Entericus (Ebel,1836); Biliogastric Fever (Copland,1844); Gastroenteric and Gastrosplenic Fever (Craigie,1837); Endemic Fever,Autumnal Fever (Flint,1852); Intestinal Fever (Budd, 1856); Night-Soil Fever (Brown,1855); Ileo-Typhus (Griesinger,1857); Cesspool Fever,Pythogenic Fever (Murchison,1858); Sepimia (Hare,1853); and Mountain Fever (1870). It has been objected to the name "typhoid fever" as a common designation for this disease that it tends to perpetuate the mistaken impression that typhoid fever is only a modified typhus fever,and also that the word typhoid has been generally applied to a condition of the system which is common to a great many different diseases and which is not of necessity present in this - viz.,the typhoid state. Although these objections are not without force, I prefer to use the name typhoid fever because it was

that first given to the disease by Louis to whom we owe the first full and accurate description of it,as well as by reason of its being the designation by which it perhaps best known throughout the world. The name"pythogenic fever" rests upon a theory of the disease (its putrid source) which has never been proven:it is now,therefore, entirely abandoned.

H I S T O R Y.

Owing to the necessarily limited restrictions of space, I do not purpose giving more than the merest outline of the many interesting points comprised in the history of the important affection under consideration.

It is the general belief that our knowledge has come down to us from a remote antiquity.Certain passages in the writings of Hippocrates have been appealed to by Murchison and others in support of the opinion that typhoid fever was a disease of at least occasional occurrence in ancient times;but,although from the nature of its causes it is probable that it has occurred in all ages and wherever men have congregated in towns and villages,the description given by Hippocrates in the passages alluded to are not sufficiently full to render it at all certain that typhoid fever has come under observation. Indeed,there is no author of an earlier date than Spigelius (De Febre Semitertiana,Frankf.,1624;Opera Omnia,Amsterdam,1745) whose writings furnish any positive evidence that he ever met with the disease. Spigelius,however,in spite of the doubt thrown upon his observations by Hirsch (Handb.der Histor.-Geogr.Path.,Stuttgart, 1881),would seem to have had opportunities of examining the bodies of those who had died of it,since he gives an account of several autopsies,in which he states that the small intestine was inflamed,and that that part of it next the caecum and colon was frequently ulcerated. Paronolus (Observat.Med.Pentacostae,Romae,1652) also states that the intestines had the appearance of being spacelated in some cases observed by him in Rome a little later in the same century. Willis (Practice of Physick,Translation by Samuel Pordage,London,1684) would certainly appear to have been familiar with two forms of fever, which,from the description he gives of them,could have been nothing else but typhoid and typhus fevers.Sydenham (Works on Acute and Chronic Diseases,With a Variety of Annotations by George Wallis, London,1788) also described a fever in which the prominent symptoms were diarrhoea,vomiting,delirium,a tendency to coma,and epistaxis, and which was sometimes distinguishable from febris pestilens by the absence of a petechial eruption. Baglivi (Opera Omnia Medico-Practica et Anatomica,Paris,1788),of Rome,in the latter part of the seventeenth century,described the haemitritaeus of previous writers under the title of febris mesenterica,and maintained that it was always accompanied by,and dependent upon,inflammation of the intestines and enlargement of the mesenteric glands. A similar observation was made soon afterwards by Hoffmann (Opera Omnia Physio-Medico,1699),and by Lancisi (Opera Omnia,Geneva,1718),in 1718. The latter seems to have fully recognised the characteristics of the eruption,for he says that it consisted of elevated papules which disappeared completely on pressure.In 1759,Huxham described,under the title "slow nervous fever", a disease which there can be no doubt was typhoid fever. Moreover,he points out very clearly the distinctions between this disease and another to which he gave the name of "putrid,malignant, and petechial fever" Sir Richard Manningham (The Symptoms,Nature, etc.,of the Febricula or Little Fever,London,1746) also described typhoid fever under the title of "febricula or little fever". In the preface of his work he calls attention to its insidious origin,and to the fact that its gravity was sometimes underrated at its commencement.About the same time Morgagni (Cited by Hirsch: loc.cit.) described certain post-mortem examinations in which the lesions were evidently those of typhoid fever. Riedel,Roederer,and Wagler,Stoll, Rutty,Sarcone,Pepe,Fasano,Mayer,Wrenholt,Sutton,Bateman,Muir,Edmonstone,Prost,Petit and Serres,Cruveilhier,Lerminier,and Andral are other writers whose works bear evidence that they were familiar with the symptoms or lesions of this disease. But,the credit of having first distinctly pointed out the association between certain symptoms and the lesions of the solitary and agminate glands of the ileum appears to belong to Bretonneau (Cited by Trousseau,Arch.Gén.,1826) of Tours.

He regarded the disease of the intestinal glands as inflammatory, and, therefore, gave to it the name of "dothienentérite" or "dothienentérie"; but, unlike Prost, fully recognised the fact that there was no necessary relation between the extent of the intestinal lesions and the gravity of the symptoms. Hirsch (loc.cit.), however, claims this honour for Pommer. The lesions of the intestinal glands which occur in this disease were also fully known to Louis. About this time the progress in pathology was temporarily impeded by the fact that while typhoid fever was of frequent occurrence in Paris, typhus fever was comparatively rarely met with, and had not been epidemic there for several years. Bretonneau, Chomel, Louis (Anatomical, Pathological, and Therapeutical Researches on the Disease Known under the Names of Gastro-Entérite, etc., Paris, 1829), and, indeed, the greater number of the contemporary French physicians, fell into the error of supposing that the fever which was then common in England was identical with that which they were describing; while the English physicians of that period, with but few exceptions, contended, with equal strenuousness, that there was but one form of continued fever, and that this was seldom associated with disease of the intestines. In the second edition of his work, Louis abandoned his former opinion, and admitted that the typhus fever of the English was a very different disease from that which formed the subject of his treatise; but the confusion which existed in England in regard to this disease was not completely dispelled until the appearance, in 1849, and the following two years, of several papers on this subject by Sir William Jenner (Med.-Chir. Trans., Vol.xxxiii; Edin. Monthly Jour. of Med. Sci., Vols. ix and x, 1849-50; and Med. Times, Vols. xx, xxi, xxii, xxxiii, 1849-51), in which it was conclusively demonstrated that typhoid and typhus fevers were separate and distinct diseases. In Germany, however, the identity of these diseases was recognised as early as 1810 - about which date, or not long after, they received the names "typhus exanthematicus" and "typhus abdominalis", by which they are still generally known in that country. American physicians very properly claim the credit of having materially contributed to the knowledge of typhoid fever. In 1824, the disease was described by Nathan Smith (Med. and Surg. Memoirs, Baltimore, 1831), under the name of "typhus fever of New England"; and, in 1833, E. Hale, Jr. (Observations on the Typhoid Fever of New England, Boston. Med. Mag., 1839), of Boston, published an account of three dissections of persons considered by him to have died of the disease. In reference to these cases, Bartlett (The History, Diagnosis, and Treatment of the Fevers of the United States, 1842) says that if the diagnosis could be looked upon as certain and positive, they would certainly constitute the first published examples of the intestinal lesions of New England. In February, 1835, William S. Gerhard of Philadelphia, who was then under the impression that the two diseases were identical, reported two cases under the name typhus fever - the symptoms and post-mortem appearances of which he showed to differ in no respect from those he had been accustomed to see in the cases of typhoid fever he had observed with Louis in Paris. The following year, however, Gerhard had the opportunity of observing an epidemic of true typhus fever; and he was at once struck with the difference between the symptoms of the cases which then came under his care and those which he had seen in Paris. He now points out (Amer. Jour. Med. Sci., Feb. and Aug., 1837) very clearly the differential diagnosis between the two diseases; and he especially insisted upon the marked difference between the petechial eruption of typhus and the roseolous eruption of typhoid fever. He showed that the latter affection was invariably associated with enlargement and ulceration of Peyer's patches, and with enlargement of the the mesenteric glands; and that these conditions were never presented in the former. He also fully recognised the fact that typhus fever was eminently contagious; while, on the other hand, he was fully aware that typhoid fever was not contagious under ordinary circumstances, although in some epidemics he had strong reason to believe it so. Indeed, the appearance of this contribution marked an epoch in the history of typhoid fever. Murchison, when speaking of it, says that to Gerhard and Penonock (who was associated with Gerhard in his observations) certainly belongs the credit of first clearly establishing the most important points of distinction between this disease and typhus fever. It is undoubtedly owing to it, more than to any other cause, that the differential diagnosis of the two affections was perfectly understood by the great body of the profession in America long before the question of the relation which they bore to each other was definitely settled in this

our own country,or even in France. The honour of having first clearly pointed out the distinguishing characteristics of typhoid and typhus fevers has been claimed by Sir William Jenner;but,as has been shown above,his papers on this subject were not published until thirteen years after that of Gerhard had appeared. The entero-mesenteric lesions in five undoubted cases of typhoid fever were,in 1835,described by Bartlett (Med.Mag.,June,1835) as corresponding exactly to those reported by Louis. In the same year,Jackson,Jr.,of Boston,published an account of the intestinal lesions observed by him in cases during the years 1830,1833,and 1834;and,again,in a Report on Typhoid Fever Communicated to the Massachusetts Medical Society,in June,1838,he affirms that the alterations of Peyer's patches had been noticed at the Massachusetts General Hospital previous to 1833,in cases in which the examination made was very thorough. In 1840, Shattuck (Amer.Med.Examiner,1840),of Boston,gave an account of some cases of typhoid and typhus fevers which he had observed at the London Fever Hospital in the previous year.In this paper,which had been already communicated to the Medical Society of Observation of Paris,and which had unquestionably exerted a marked influence upon medical thought there,he pointed out very fully the distinguishing characteristics of each disease. Bartlett, in 1842,issued his work on The History,Diagnosis,and Treatment of the Fevers of the United States,which contains very full descriptions of both of these affections,and of the means by which they may be distinguished from one another. Since then there have been numerous additions to the literature of typhoid fever in various parts of the globe. To Murchison (A Treatise on the Continued Fevers of Great Britain,London,1873),however,is justly due the credit of having produced the most elaborate and classical treatise on the disease in any language. The various points in connection with the history of the discovery of the pathogenic micro-organism of typhoid fever will be considered presently.

GEOGRAPHICAL DISTRIBUTION.

Notwithstanding the fact that the conditions of civilisation undoubtedly favour the occurrence and extension of typhoid fever,yet, there is abundant evidence to show that they are not absolutely necessary to its production - as there is no country,whether civilised or not,in which it has not occasionally made its appearance: it is at times encountered under all conditions of climate. The disease is endemic in the British Islands;in almost all parts of Continental Europe;and in North America. Hirsch (loc.cit.) has reached the conclusion that its general prevalence in Europe and America dates no further back than the second and third decades of the nineteenth century - that is,from the period at which typhus became everywhere less common,and in many regions disappeared altogether. In America it is endemic also - attacking the inhabitants of Greenland and British America,and those of Mexico; it prevails from time to time in every State of the Union - committing its ravages as well among the rocks and hills of New England as in the more fertile valleys of the West and South. In new and sparsely-settled American districts, where the land is being gradually brought under cultivation,malarial fevers occur;after a time,as populations increase,malaria and typhoid fever prevail side by side;finally,when the land has been generally taken up,drained and tilled for some generations,and villages and cities abound,malarial fevers impress communities but faintly,or disappear altogether;while typhoid fever becomes common,and asserts itself as the predominant and endemic fever in proportion to the neglect of the sanitary measures,by which alone it can be kept in in populous localities. Typhoid fever has also occurred in Central America and the West Indian Islands. It has prevailed from time to time in the States of Southern America,and occasionally assumed in some of them - as,for instance,Brazil and Chili - an epidemic form. The disease exists endemically in every country of the continent of

Europe - from Sweden and Norway in the north, to Turkey in the south; and in some of them - as, for instance, France and Germany - would seem to be of particularly frequent occurrence as compared with our own country. The literature of the disease is also by no means deficient in evidence that it has prevailed at various times in all the different countries of Asia and Africa, Australia, and in India. The malady is also far from uncommon in tropical and subtropical countries generally. In short, wherever peoples abound, there may typhoid fever be encountered.

ETIOLOGY.

Typhoid fever is due to the implantation, in a susceptible organism, of a specific infecting principle - the bacillus of Eberth or bacillus typhosus; and through the agency of this the disease is propagated.

Predisposing Influences.

These constitute all the conditions which favour the development and accumulation of the infecting principle, as well as those factors which increase the susceptibility of the individual to the cause of the disease and the liability to exposure to the same.

AGE.

Of all conditions determining the individual predisposition to typhoid fever, age is the most important. According to all experience, the greatest predisposition exists between the ages of 15 and 30. Thus, according to Murchison's statistics, more than half (52 per cent.) of the cases brought into the London Fever Hospital were in persons from 15 to 25 years of age, and in more than a fourth the patients were under 15 years. On the other hand, in less than a seventh they were over 30, and in only 1 in 71 did the ages exceed 50 years. Taking these facts in connection with the circumstance that the entire population of England and Wales in 1861 was 12,481,323 persons under 30 years of age and 7,584,901 above 30, it follows, he says, that persons under 30 are more than four times as liable to typhoid fever as persons above that age. Children less than a year old are very seldom attacked; but, from this period up to 15 years of age, the liability steadily increases. No age, however, enjoys a complete immunity from the disease. In 1864, Murchison showed, at the London Pathological Society, the intestines of an infant six months old who had been attacked at the same time as her mother. Manzini (Cited by Murchison; loc.cit.) once saw a case in which lesions similar to those of typhoid fever were found in a seventh-month foetus which died within half an hour after its birth. Cases are also on record in which death had occurred from this disease in the first few weeks of life. The explanation of the fact that the proportion of cases occurring in infancy is smaller than that of childhood is sought in the increased exposure to the infecting principle at those times further on in life. It has, moreover, been suggested that typhoid fever is of even more frequent occurrence in children than is generally supposed, as this class of patient is not often admitted to general hospitals; and, owing to the absence of some of its characteristic symptoms, the disease often escapes recognition when it occurs in those of tender years. Taking the other extreme, typhoid fever is not common in advanced life, though well-authenticated cases in the elderly or the aged have been reported. Thus, 83 out of 5,911 cases were observed at the London Fever Hospital in persons over 50; 27 in persons over 60; and in 2 the age was 75. In a case reported by D'Arcy, the age of the patient was 86; and, in one reported by Hamernyk, it was 90. It is many years now since Bartlett contended that the disease was not so rare as was generally supposed among

persons over 40 years of age;and there is really no good reason to believe that the susceptibility to the malady in an unprotected person diminishes with advancing years - the immunity which elderly persons appear to enjoy to the disease being probably due to the fact that,as the affection is common in early life,they are in many instances protected by having already passed through an attack.

SEX.

The statistics of all general hospitals,with very few exceptions,show a greater or less preponderance of males over females among the typhoid fever patients treated in them.This fact is not by itself to be considered as proof that men are really more often attacked than women;for in most places more of the former than the latter seek hospital treatment. According to Murchison,there were in the London Fever Hospital,out of 5,988 typhoid patients,3,001 males and 2,987 females,during a period of 23 years. Of 891 cases admitted into the Glasgow Infirmary during 12 years,527 were males and 364 females. According to Fiedler,there were in Dresden 862 male and 635 female typhoid patients - that is,56.6 per cent.of the former class and 42.4 per cent.of the latter.Occasionally the difference is even greater than is indicated by these figures. Thus,of 138 cases observed by Louis,all but 32 occurred in males.When,however,we consider that the proportion of men who apply for admission to hospitals when sick is much larger than that of women,we can scarcely accept these statistics as proof that the former are more liable than the latter to be attacked by typhoid fever.Indeed,the opinion which Murchison expresses is generally accepted as correct - namely, that neither sex is more likely than the other to contract the disease.Furthermore,statistics that have been from time to time adduced to show that the disease is much more frequent in boys than in girls embody the fallacy arising from a failure to appreciate the fact that beyond the age of infancy girls are much less exposed, under ordinary circumstances,to the infection than boys.The latter, in their out-door sports,bathing,swimming,and the like,are not only in frequent danger of inhaling the concentrated emanations from sewers and drains,but are also subject to the liability of imbibing sewage-polluted water. In contrast with many other diseases, typhoid fever is said to attack,by preference,strong and healthy persons;while it avoids pregnant and nursing women.Nathan Smith, however,asserts that while the sexes are equally liable to it,more women are cut off by typhoid fever than men;and this in consequence of its appearance in them during pregnancy or soon after child-birth.

MODE OF LIFE.

The influence of occupation inpredisposing to typhoid fever does not appear to be great.The disease,however,seems to exhibit a marked predilection for the affluent and cultured classes of society. Why this should be is difficult to explain.Some authors point to the arrangement of bath-rooms and water-closets in too close proximity to the bedrooms in the houses of the affluent.

CHANGE OF RESIDENCE.

It has often been affirmed that newcomers to a locality are much more liable to be attacked by typhoid fever than persons who have lived for some time in a place where the disease prevails.In 129 cases examined with reference to this point by Louis,the patients in 73 had not resided in Paris more than ten months,and in 102 not more than twenty months. Bartlett noticed that,during an epidemic in Lowell which he had the opportunity of observing,the disease attacked the recent residents in much larger proportion than the old ones. Murchison's experience in reference to this point has been somewhat similar;for he found,upon examination of the records of the London Fever Hospital,that 21.84 per cent.of the patients admitted therein for typhoid fever had been citizens of London for less than two years. Almost all of these patients came,he says,from the provinces,and were in good health and comfortable circumstances at the time of their arrival in London,as well as for some time thereafter. Moreover,a large proportion of them were attacked first within a few weeks after changing their residence from one part of London to another.He also refers to instances in which successive

visitors at the same house at intervals of months,or even years, have been seized shortly after their arrival with typhoid fever or with diarrhoea,from which same the ordinary occupants were exempt. Trousseau noticed that visitors to Paris were more liable to typhoid infection than the natives;and the experience of those who have studied the subject,in places where typhoid is rife,is in agreement with these observations. Facts like these indicate,with sufficient clearness,that habitual exposure to the cause of the disease confers,to a certain extent at least,an immunity to the same.

SEASON OF THE YEAR.

This appears to be a predisposing influence of great importance. Typhoid fever occurs with greatest frequency in this country,as it usually does elsewhere,during the latter half of summer and the early part of autumn.Indeed,its greater prevalence at this season than at other times has given to it the name of "autumnal fever", by which it is popularly known in many parts of England.On the other hand,the disease is at its minimum in May and June.Hirsch (loc.cit.) found that 519 epidemics of typhoid fever were distributed as follows: In the spring,29;in the summer,132;in the autumn,168;and in the winter,140.Of 116 circumscribed epidemics,occurring in France, between 1841 and 1846,recorded by De Claubry,20 began in the first quarter of the year,21 in the second,39 in the third,and 36 in the fourth.The number of cases,however,does not immediately diminish upon the onset of cold weather.On the contrary,it has sometimes been observed that,after diminishing in November,they have shown a marked increase in December.Of 5,988 cases treated at the London Fever Hospital,Murchison says 759 were admitted in the spring,1,490 in the summer,2,461 in the autumn,and 1,728 in the winter.Of the whole number,27.7 per cent.were admitted in the two months of October and November,and in April and May only 7.3 per cent. Hirsch (loc. cit.)mentions that in Rio de Janeiro the maximum of the disease occur-s in the months from March to June,or,in other words,in the season in which the latitude corresponds to our autumn.There are, however,some exceptions to the general rule of the greater prevalence of the disease during autumn.Bartlett,who was aware of its greater prevalence at that time,refers to an extensive and fatal epidemic which he observed at Lowell during the winter and early spring:other places have had similar visitations. The prevalence of typhoid fever appears to be markedly influenced by the state of the weather as regards dryness and moisture.Hot and dry summers favour the development of the disease:cold and wet summers check it.This statement is supported by the concurrent testimony of observers in all countries.Dryness of the atmosphere alone does not,however,lead to an increase of the disease.In cities,and other localities possessed of a system of underground drainage,warm and damp weather often leads to an outbreak of typhoid;while heavy rains,by flushing out the drains,remove the causes to which its origin and spread are chiefly due.On the other hand,outbreaks of typhoid fever may be traced to the influence of abundant rains in washing the germs of the disease into the water used for drinking purposes - especially when manured fields are the sources of its supply. Buhl and Pettenkofer have endeavoured to establish a direct relationship between the prevalence of enteric fever and the height of the deeper springs of water.When the water rises,the number of cases of typhoid fever diminishes;when the water sinks,the number of cases of the disease increases.This relation holds true for Munich,Berlin,and some other places.It has not,however,been satisfactorily explained.The observation corresponds with the statement,above made,that typhoid fever is a much more frequent disease after hot and dry summers than after cold and wet ones.These observers seek to explain the varying prevalence of typhoid fever,in connection with the changes in the ground-water,by the assumption that the ground-soil is the chief place of development for the specific micro-organism of the disease. When the water-level sinks,the layers of earth,containing moist organic substances,are exposed to the air,and undergo changes which lead to the development of the fever-poison;when,on the contrary, the sub-soil water rises,these layers of earth are covered,and the development of the germs is arrested. Nevertheless,these views of

Pettenkofer and his pupils lack confirmation,and have not,therefore, been generally accepted.Furthermore,as pointed out by Murchison, the theory fails to account for the connection which is frequently observed between defective house drainage and outbreaks of typhoid fever occurring irrespectively of any variation in the sub-soil water.Again,outbreaks of the disease have occurred under precisely opposite circumstances - e.g.,the outbreak at Terling,in 1867,- recorded by Thorne,- which was actually coincident with a rise in the level of the ground-water after a period of drought.

DEBILITATION.

Typhoid fever does not appear to attack by preference either those in an infirm condition or those recovering from an illness. Some,however,go so far as to insist that the disease does so afflict the robust,while it avoids those suffering from chronic ailments. Physical and mental fatigue,as well as intemperance,-except in so far as they lower the powers of resistance against infection,- do not predispose to typhoid fever.

IDIOSYNCRASY.

We may here note that considerable importance has been attached by various authors to idiosyncrasy as a predisposing cause of typhoid fever.There can be no question that the latter occurs much more frequently,and is much more fatal,in somefamilies.Still,we do not exactly know the nature of the peculiarities of constitution which increase the liability to infection.

UNSANITARY CONDITIONS.

The time-honoured theory,that typhoid fever is solely and essentially a disease of filth,has now been abandoned;yet,that filth is an important factor in its propagation is still recognised - for it forms a suitable breeding-place or nidus for the germ. The fons et origo of the disease is polluted water.All sewage-polluted water does not,however,contain the typhoid poison;but such water is more likely to do so than that not so contaminated.This fact has been repeatedly proved in whatever places adequate water supplies and efficient sewerage systems have been introduced,with a view to making the sanitary conditions as ideal as possible.

GEOGRAPHICAL LOCATION.

We have already seen that the geographical distribution of typhoid fever is wide,and that it prevails in all countries and in every clime e being,however,especially prevalent in temperate zones.

The Exciting Cause.

It is now a matter of absolute certainty that the cause of typhoid fever is the specific micro-organism known as the BACILLUS TYPHOSUS or BACILLUS TYPHI ABDOMINALIS. We owe to Eberth (Brit.Med.Jour.,Nov.26,1881;Virchow's Arch.,Bd.81,83) the first definite ideas regarding its characteristics.Examining,- by means of sections clarified by acetic acid,- the spleen,the lymph nodes, Peyer's patches,the liver,the kidneys,and the lungs in 23 typhoid fever cases, he found in the lymph nodes clusters of micro-organisms. Later,by staining with methyl-violet,he demonstrated the presence of germs in scrapings from the spleen and lymph nodes of the same class of patients.Being unable to find any such microbes in other diseases,- even when complicated with intestinal lesions,- he claimed a specific relation to typhoid fever for the bacillus he had thus discovered. Photomicrographs,taken by Koch at the same time and independently of Eberth,showed that he had observed this same bacillus in the liver,spleen,and kidneys in cases of typhoid fever.The discovery of Eberth was also confirmed by Meyer in Germany,and by Coates and Crooke in our own country. A valuable contribution to the study of Eberth's bacillus was made by Gaffky,

who,in 1884,first obtained it in pure culture in gelatin,as well as on various other culture media.Gaffky,moreover,made a complete study of the micro-organism,in which he reviewed its characters of morphology,distribution in the body,and experimental reactions in animals.He was,however,unable to prove its pathogenic nature. Subsequent research has detected few errors in Gaffky's observations, but has generally confirmed themStill,many facts have been added in regard to the identification,biology,and pathogenic properties of this bacillus.One of the most striking features of its subsequent history is the attempt made,by Roux and Rodet,to identify the colon bacillus and that of Eberth - an attempt which aimed at nothing less than to rob the bacillus typhosus of all specific character, and to re-establish on a biological basis the theories of Murchison. The doctrine,so ably defended by Murchison and his followers,that the specific cause of the disease may be generated de novo in sewage without the presence of typhoid excreta,is no longer tenable. There is no proof whatever that typhoid fever can,in the absence of the specific pathogenic bacillus of Eberth,be produced by the products of decay or decomposition,by tainted food,or by the action of other bacteria;nor is there any reason to believe that typhoid bacilli can originate from other micro-organisms.

Morphology.

The bacillus typhosus occurs in the form of very motile, slender rods 1 to 3 mm.long by 0.5 to 0.8 mm.thick,sometimes growing out into filaments.The size of the rods varies considerably in specimens obtained from various sources.The bacilli from agar cultures, grown at blood temperature,and from the tissues of animals and human beings appear smaller in all dimensions than when grown on gelatin and potato; on which media,especially at low temperatures, they frequently take the form of long threads.The single rods are straight,regular in outline,and with blunt,but rounded,extremities. In stained specimen from cultures,they are often slightly curved. The bacilli from old cultures also often appear somewhat irregular in shape.They are readily stained with all the common aniline dyes; but they easily part with their colour when treated with decolourising agents - e.g.,the iodine solution of Gram.They are somewhat more difficult to stain than most bacteria;but there is no constant difference between them and other germs in this respect.Refractive granules are not infrequently seen at the poles of the bacilli - especially on potato cultures.These are readily and intensely stained by aniline dyes.There may also be vacuoles,situated at the poles or centrally or along the sides of the rods,which may remain unstained.These appearances are not due to spore-formation,but to retrogressive changes - for the cultures in question have less power of resistance than those of the usual type. Although Gaffky and others announced the discovery of spore-formation,subsequent investigation has not substantiated their claim.The existence of spores has again been asserted by Almquist.From his description,they would appear to be quite different from true endogenous spores;but,in regard to their power of resistance,no experiments were detailed.The movements of the bacilli may be described,in the case of the smaller individuals,as rapidly swinging and tumbling in character - the larger bacilli progressing in a more serpentine manner,which is most pronounced,but slower,in the longer threads.They propel themselves by means of some ten or eighteen flagella,which are distributed over the entire surface of the cell.These appear as slender sinuous threads,from three to five times as long as the bacilli.Loeffler's stain, - consisting of a solution of tannin and ferrous sulphate as a mordant,to which is added a certain proportion of a one-per-cent.solution of sodium hydrate with fuchsin or methyl-violet,- shows up their appearances quite satisfactorily.

Cultivation.

The bacillus typhosus grows readily in a variety of culture media at"room temperature";very scantily from 9° to 15°C.;and most abundantly at 37° C.(body temperature).Its development is impeded at 42°C. The presence of oxygen is advantageous,but not necessary to its existence.It grows readily in gelatin without producing liquefaction. Superficial colonies on gelatin,early in their development,have a somewhat characteristic appearance.They are transparent,iridescent,

and have an irregular outline,which is compared to that of a grape leaf.Deep colonies are spheroidal and of a yellowish colour,gradually changing to brown.Cultures in bouillon give it a uniform cloudy appearance.No pellicle is formed on the surface. On potato the appearances of the growth are variable,according as the reaction of that vegetable is alkaline or acid.The appearance as described by Gaffky may be considered as typical.This consists of an "invisible growth" covering the entire surface and causing a smooth and glistening appearance.At times the growth is more luxuriant and of a yellowish or brownish colour,resembling an ordinary culture of the colon bacillus.The bacillus typhosus grows feebly,or not at all, in solutions containing asparagin.It does not produce indol in solutions of peptone,or in bouillon;nor does it cause fermentation of grape,milk or cane sugar.It causes the formation of acid from grape sugar,but no gas.It grows readily in milk,producing a slightly acid reaction;but it does not cause coagulation.It turns strongly alkaline media which do not contain sugar.In regard to its power of reduction,observations vary.According to Germano and Maurea,only a slight reduction of indigo sulphate of sodium takes place regularly in the case of agar stab-cultures;whereas the vast majority of the colon group are powerful reducing agents.Loesener states that there is only a slight difference in this respect.Nitrates are reduced to nitrites,and sulphate of hydrogen is evolved;but less energetically than in the case of other bacteria.Hugonneng and Doyen found that both the typhoid and the colon bacilli set free nitrogen in peptone solutions containing 1.5 per cent.of sodium or potassium nitrate. They are very similar in this respect,in both the degree and rapidity of the reaction.No pigment is formed by the bacillus typhosus. When filtered of living bacteria,the cultures produce marked symptoms of poisoning in animals;and this is due to the toxins which they contain.

Pathogenesis.

The typhoid bacillus is found in both soil and water;but only when these are polluted by the discharges from typhoid patients. Loesener claims to have discovered in five instances typhoid bacilli in soil,tissues,and faeces in which there had been no suspicion of their presence.They have never been demonstrated in the healthy body. During the course of typhoid fever,however,they are widely distributed throughout the body,as well as in the excreta.Cultures are obtained with great certainty from the spleen and lymph nodes of the mesentery,in which the bacilli are found scattered about in little clusters.This arrangement in scattered clusters is characteristic; and,as a rule,it is only in the walls of the intestine that they are observed singly or in loose chains following the course of the lymphatic vessels.There can be no question that the groups of bacilli are formed during life.The proof of this,according to Flügge and others,consists in evidence of retrogressive changes in the rods - as shown by a poor reaction to stains.On the other hand,there is a possibility that the bacilli proliferate also after death.This distribution in the tissues,although characteristic,is not peculiar to the typhoid bacillus,for the colon organism may be found similarly grouped.The typhoid bacilli show a preference for the lymphatic system - choosing first the solitary and agminated glands of the intestine,then the mesenteric lymph nodes,and lastly the spleen. The liver and kidneys are invaded to a less extent.Quincke and Stuhlen say they can almost always be found in the marrow of the bones.The distribution of the bacilli in the body can only be explained by the theory that they enter the general circulation.This theory has also been confirmed by the direct examination of the blood. Although Gaffky,Janowski,Grawitz,and others have not been successful in such examinations,- being perhaps deceived by contaminations with other bacilli,- many positive results can be cited.Stern observed the bacillus typhosus in 3 out of 6 cases;twice in the blood from the rose spots;and once in that from a vein.Banti succeeded in 1 out of 2 cases.Neuhaus,in blood from rose spots,obtained cultures in 9 out of 15 cases examined.Fraenkel and Simmonds in 6 cases found the bacillus once.Thiermich,examining the blood of 7 cases,drawn both from veins and rose spots,obtained a growth of typhoid bacilli three times from the eruption and once from a vein.In 41 cases,he examined

blood taken from a vein with elaborate antiseptic precautions,and in 9 cases he obtained a growth of typhoid bacilli.By a similar method of vein puncture,and using a smaller quantity of blood, James and Tuttle succeeded three times in 38 cases. The blood stream may,of course,carry the bacilli to all parts of the body, and they may be deposited in the central nervous system.Curschmann has reported on a case in which he found them in the white substance of the spinal cord - distributed for the most part singly,rather than in groups.The case presented symptoms resembling those of Landry's paralysis,and the spinal cord showed only unimportant histo-logical changes.That the typhoid bacilli can also pass from the maternal circulation to the foetus has been shown by Neuhaus,Eberth, Fraenkel and Kiderlen,Hildebrandt,and others.In experiments upon animals,Frascani was regularly able to demonstrate the bacilli in the foetus. Bacteriologists have frequently demonstrated the presence of the bacilli in the faeces of typhoid patients.It is probable that they are not evenly distributed through the faeces, and that they are most abundant during the period of active intestinal ulceration.The failure to demonstrate their presence at any given time in the disease cannot be considered proof positive of their absence.The identification of the typhoid bacillus in faeces is difficult at the best,and in the multitude of other similar bacteria it may easily escape detection. It is very often present in the urine also,appearing probably somewhat later than in the faeces.Neumann obtained typhoid bacilli in cultures from the urine in 11 out of 48 cases,and once as early as the third day. Slight changes in the kidneys always take place in the course of typhoid fever,and they may sometimes be of a serious nature.The bacilli do not often appear in the sweat,but Geissler claims to have found them there on one occasion.The assertion made by Siccard, that they may be present in the expired breath,is improbable. The discovery,by Lucatello,of typhoid bacilli in saliva and in the mucous membrane of the larynx,has not been confirmed.In 19 out of 22 cases Chiari found the bacilli in the gall-bladder.How they effect entrance to that viscus has not yet been satisfactorily explained. Tissues immediately surrounding the groups of bacilli appear to undergo no histological changes.Many cases have been reported,however,in which typhoid bacilli have acted as the excitants of inflammation and suppuration;and their power in this respect has been proved by experiments on animals.Fraenkel has reported an encapsuled focus of pus in the peritoneum.Weichselbaum saw a case of general peritonitis following rupture of the spleen.Many have reported suppurative processes connected with the bones - e.g.,periostitis and osteomyelitis.Typhoid bacilli have also been obtained,in pure culture,in cases of suppurative meningitis.Flügge,in view of the possibility that other bacteria,after having assisted in the production of these lesions,have disappeared from the field,believes that there is no reason for assuming a specific typhoid form of inflammation.

Identification.

The importance of the recognition of the typhoid bacillus is commensurate with the difficulty arising.Before the publication of Gaffky's researches,in 1884,microscopical appearances and certain staining peculiarities were depended upon for its detection. Since that time improved methods of study and many important discoveries have shown that the morphology and staining properties of this bacillus are not sufficient to identify it:indeed,they are now known to be of comparatively slight importance.Brieger,in 1884, Emmerich,in 1885,and Escherich,in 1886,discovered in human faeces certain micro-organisms which,although given different names by their discoverers,were probably identical,or at least variations of, one species.The name given by Escherich to the organism isolated by him,Bacterium coli commune,has been retained in slightly altered form - viz.,Bacillus coli communis or colon bacillus.The study of this micro-organism by different bacteriologists seems to show that the term colon bacillus applies to a species which comprises many varieties of similar bacilli,but which are distinguished from each other by slight biological and microscopical differences.In general,the colon bacilli resemble closely the typhoid bacillus in form,size,staining properties,biological

characteristics,and pathogenic effects in some of the lower animals. The distribution and arrangement of these bacilli in the tissues are practically the same as in the case of the typhoid bacillus. They are found constantly in the intestinal canal and faeces of human beings,and also in those of many,if not all,of the lower animals.The problem,then,which has occupied the minds of bacteriologists has been to find a sure and rapid method of distinguishing the bacillus typhosus from the different varieties of the colon bacilli,and such other bacteria as in any way resemble it.The slight difference in size may be disregarded as it is not constant,and practically not appreciable.The distinguishing features which may be relied upon to identify the typhoid bacillus are the following: (1) They are slender bacilli which grow in gelatin without producing liquefaction,and present somewhat characteristic appearances in young colonies upon the surface.When stained they are readily decolourised by Gram's method. (2) The typhoid bacillus grows less rapidly and luxuriantly upon all culture media than the colon organism. (3) It regularly possesses a greater number (10 to 18) of flagella than the colon bacillus (4 to 8). It is also more actively motile.Indeed,except in very recent young cultures,the colon bacillus shows very little and often no motility. (4) The growth of the typhoid bacillus is invisible,while that of the colon organism is conspicuous and of a dirty-yellow colour.This difference,however,is not constant,and is not reliable.According to Germano and Maurea,if the suspected bacillus be planted on one-half of a potato and a known culture of the typhoid bacillus on the other,the slightest essential difference between the two growths proves the bacilli to be different. (5) The typhoid bacillus does not produce indol in peptone solutions. (6) It does not coagulate milk. (7) It does not produce gas in lactose or glucose bouillon:the colon bacillus coagulates milk and produces gas and indol under similar conditions. (8) Another difference,emphasised by Loesener,is the strong acid reaction produced in certain medium by the colon bacillus.It produces more than twice as much acid as the typhoid bacillus in forty-eight hours. It should be borne in mind that no single one of the above tests is sufficient to distinguish the typhoid bacillus from all varieties of the colon bacillus: it is only by the concurrence of all these tests - compared in each instance with a like test of a known culture of typhoid bacilli - that a suspected bacillus can be positively recognised as the typhoid organism.The results of animal inoculations are so varied,and so little characteristic,that such experiments are practically useless in determining the identity of the typhoid bacillus.The experiments of Pfeiffer and Kolle,however, have demonstrated that animals which have been rendered immune to typhoid fever are as susceptible as usual to other bacteria of this group -e.g.,the colon bacillus.The serum of immunised animals - sometimes in a dose of only a few milligrams - acts as a protection against the typhoid bacilli only,and not against the colon organism,and vice versa. It is difficult to isolate the bacillus typhosus from such mixtures as faeces,as the latter contain innumerable bacteria of many varieties - some of them of very rapid growth and capable of liquefying gelatin. To effect this purpose many methods have been devised.The value of any such method,next to its accuracy,is determined by its rapidity and simplicity in practice.Most of the methods thus far have failed in other hands to accomplish the results claimed for them by the inventors. A medium which will permit the growth of the bacillus typhosus,while preventing or greatly retarding the growth of other bacteria,or a medium in which the appearances of the growth of this bacillus is sufficiently characteristic to distinguish it,has been sought. The ability of the typhoid bacillus to grow in slightly acid media,and in the presence of certain antiseptic agents,has been chiefly relied upon.Unfortunately,the bacilli of the colon group possess the same power,and this in even greater degree. Holz employed a preparation of gelatin in potato-juice,to which he added a mixture of carbolic acid.The reaction of this medium was slightly acid. Elsner retained the slightly acid potato-gelatin of Holz;but,in place of carbolic acid he added 1 per cent of potassium iodide. Upon this medium the typhoid and the colon bacilli developed,

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while the growth of almost all other varieties - especially those producing liquefaction - was inhibited.The groeth of the colon bacilli was rapid - the colonies being seen at the end of twenty-four hours.On the other hand,the typhoid bacilli grew slowly - so that the colonies were scarcely visible at the end of forty-eight hours;but,at the end of forty-eight hours,they could be easily distinguished by their size and colour from those of the colon bacilli.Properly carried out,this method has yielded fairly uniform results.A plate,in which the colonies are few and widely separated,offers the best conditions for a characteristic growth. When the colonnies are thickly sown,the development of all is restricted,and the distinguishing features do not appear.Using Elsner's method,Sterling succeeded in isolating the bacillus typhosus in 60 per cent.of the cases examined.He considers it a decided improvement upon previous methods. But the failure to demonstrate the presence of typhoid bacilli does not exclude the possibility of their presence.Diagnosis depends upon a positive result.A negative result is of little value. Loesener often succeeded in isolating the typhoid bacillus from the faeces by the use of simple gelatin,to which he added.05 per cent.of carbolic acid.After the development of the colonies,he transplanted into glucose-agar a considerable number of the smaller ones which seemed to be likely to be typhoid bacilli.He then subjected to further examination only the cultures in which there was no formation of gas.The time required for the practice of these methods makes them unsuitable for general purposes. Furthermore,the above-mentioned by no means exhaust the list of methods from time to time devised. The coloured media of Robin and Ramond,and those containing urine, are well spoken of by many bacteriologists. The interesting experiments of Klie,also,- with media containing different percentages of gelatin,- deserve mention. By the use of a medium containing 3.3 per cent.of gelatin at 18° to 19° C.,he obtained,after from twenty-four to thirty-six hours,a fairly constant type of colonies of both typhoid and colon bacilli.The differences,however,were not sufficiently striking as positively to distinguish them. These methods, although most of them are of little use in practice,contain many suggestions and hints;and they have contributed materially to the study of the subject. Hiss has devised a method which accomplishes the isolation and identification of the bacillus typhosus from faeces with not less accuracy,and in a shorter time,than previous procedures. Impressed by the observations of Baginsky,Rosenthal, and Klie in regard to the effects of media of reducing consistence upon the forms of colonnies,especially of motile bacteria,Hiss aimed at utilising the facts discovered by them;and this by making a medium which would have a semi-solid consistence at the temperature of the body.This method requires the use of two slightly different media containing both agar and gelatin,and having a certain degree of acidity.One is for use in plates,and the other for tube-cultures. The plate medium contains 1 per cent.of agar and 2.5 per cent.of gelatin.The proper consistence of these media is obtained at incubator temperature (30° to 40° C.).,which also favours the rapid development of bacteria.At the end of sixteen to eighteen hours,the development of colonies in the plates is sufficient to show growth characteristics;and the latter are generally distinctly different in the typhoid colonies from those of the colon group. The colonies which present the typhoid characteristics are now transplanted into the tube medium.After from sixteen to eighteen hours in the incubator,the entire medium is evenly clouded if the bacillus typhosus be present therein.On the other hand,none of the colon bacilli produce this appearance.Thus,within thirty-six hours,it is possible to isolate the bacillus typhosus from the faeces with remarkable certainty, as shown by the usual tests.The value of this method appears to be established;but,owing to the importance of strict accuracy and the necessity for securing the proper degree of acidity,it is not in general use. The serum test requires to be employed in a special way,and then only is it of real value.The procedure consists in the use of a typhoid serum from an animal highly immunised against the bacillus typhosus.This is tested against the standard typhoid bacillus,- agar culture,- and the highest dilution ascertained which gives the complete reaction in one hour.The suspected bacillus is

now tested similarly.Both specimens are those of the typhoid bacillus when they are equally sensitive to the serum;both give a complete reaction in one hour in high diluations,- over 1 in 500,- and respond to the other required tests. Pfeiffer's test may be reserved for use in cases in which a bacillus gives all the morphological and cultural tests of the bacillus typhosus,but fails partly to satisfy the preceding test.It consists in injecting a ten-times-fatal dose of the suspected bacillus into the peritoneum of a guinea-pig,as well as a very small quantity of typhoid serumfrom a highly immunised animal.If it is the typhoid bacillus,then the control animal injected only with the bacillus will die,but this animal will recover.The serum is specific;it only protects,in minute doses,against the typhoid bacillus;so that the animal will certainly die,just like the control animal,if the bacillus is not that of the disease under consideration.

Persistence.

The question of the length of time that the typhoid bacilli can exist within the body after the patient has recovered is one that has been the subject of considerable investigation. It seems certain that the bacillus typhosus may remain alive in the body for months - it has been said for several years - under favourable circumstances.Buschke tells that cultures of typhoid bacilli were obtained from an old focus of inflammation in bone seven years after the time of original infection. Sahli states that he found typhoid bacilli in a pleural effusion fifty days after the beginning of enteric fever. Orloff demonstrated their presence, in the granulation tissue of afocus of periostitis,after six and a half months. Chantemesse saw them in the pus of osteomyelitis nine months after a severe attack of typhoid fever. Werth found them after eight months in the contents of a suppurating ovarian cyst. Valentia Loriga and Pensuti,and Fasching have found them after various periods. Hinze was able to isolate them from the pus of a costal periostitis ten months after the termination of an attack of this disease.

Vital Resistance.

In all probability,as spores are not formed by the typhoid bacilli,their power of resistance is not greater than that of other non-sporogeneous bacteria.They are not destroyed by moderate degrees of heat.Sternberg found a moderate exposure (ten minutes) to a temperature of 56° C. sufficient to kill them.Potato cultures, containing the refractive granules described by Gaffky as spores, were regularly killed by a temperature of 60° C.,in order to secure their destruction.An exposure to 65° C.for five minutes likewise destroys them.Long exposures to very low temperatures does not seem to injure their vitality.Prudden found the typhoid bacilli alive, after an exposure of more than three months in ice,at -11° C. Janowsky states that exposure to direct sunlight for from four to eight hours will kill them.It is with only moderate rapidity that drying destroys the bacilli.Gaffky found them alive after three months. Uffelmann,testing them in a dried garden earth,white sand, buckskin,and wood protected from sunlight,found them alive after from twenty-one to eighty-two days. But,in experiments reported by Flügge and by Paffenholz,they always succombed within five to fifteen days,when dried in thin layers. Typhoid bacilli may retain their vitality in cultures for months when under favourable circumstances. Sternberg found them alive more than twelve months in a particular case. Amnumber of observations have been made as to the length of time the typhoid bacilli may live in water.No definite rule can be formulated from these investigations,as they vary widely. Hochstetter,in 1887,working with distilled water,found five days to be the minimum duration of life of the bacilli in this liquid.Strauss and Dubarry found them alive in the sterilised waters of Ourcq and of the Vanne after eighty-one and forty-three days respectively. Hueppe,in the waters of a very impure well,found them alive for thirty days.In this connection Jordan's experiments are interesting.He found that the age of the culture influences greatly the life of the bacillus in water.A fresh and isolated culture possesses distinctly greater vitality than one which has been under cultivation for several months. In sterilised lake water,the bacillus typhosus does not multiply to any extent;but,under certain

conditions,it may maintain its vitality for more than three months. Under the same conditions,the colon bacillus multiplies rapidly, and may remain alive for more than eight months.In distilled water, the typhoid bacilli perish much more rapidly than in water from a lake. Jordan found eighteen days to be the limit of vitality in distilled water for fresh cultures,while old cultures survived less than six days.A minute quantity - even 0.0126 per cent. - of nitrogenous material causes a perceptible lengthening of life in distilled water,while in sterilised water a smaller quantity suffices. These facts may explain the differences in the results obtained by various authors.The organic water,which may be introduced into the water with the specimen to be tested,may be sufficient to prolong the life of the bacilli.In natural conditions,other factors - such as sunlight,alternate freezing and thawing,competition with other bacteria,etc. - may influence the vitality of the bacilli. Flügge affirms that they usually disappear from water by the end of two weeks;but a much longer persistence may be seen under favourable circumstances. Provided the medium be of alkaline reaction,typhoid bacilli,planted in faeces from persons in good condition and kept at a temperature of 17° to 20° C.,may,according to Uffelmann,thrive for more than four months. It is important to know how long typhoid bacilli can live in soil. Investigations with reference to this point are less numerous. Grancher and Deschamps have shown that they may remain alive in soil more than five and a half months. Karlinski concluded from his researches that they do not live more than three months therein. He says that they retain their vitality in the deepest layers of the soil longer than upon the surface where they are exposed to the sun's rays. Martin found that,in soil which was polluted with organic substances,the typhoid bacilli speedily increased and spread abroad;while,in virgin soil, under like conditions,they diminished and quickly died out. In black mould,both typhoid and colon bacilli maintained their vitality for more than fifteen weeks. In virgin soil,no growth whatever occurred. Robertson also tested various soils,some of which he treated with dilute organic solutions,while others were not so treated.The results of his experiments show that typhoid bacilli are capable of growing very rapidly in some soils,and that apparently they can survive from one summer to another therein.In soil containing no organic matter,they did not survive.Cultures planted at depth of eighteen inches grew to the surface.Those planted on the surface grew downwards only three inches.They did not spread laterally to any extent in his experiments - a result which differed from those observed by others. These experiments apparently prove that it is more dangerous to bury the excreta of typhoid patients than to sprea-d them upon the surface where they become acted upon by sunlight and desiccated. Firth and Horrocks have demonstrated the fact that the bacillus typhosus is unable to grow in any direction in soil, though it may be recovered after ten weeks and four days; that the main factors affecting the chance of survival in soil are excessive moisture or great deficiency; and that the bacillus can be recovered up to the twenty-fifth day from drying sand,and from soil dried to dust. With one exception, in all of these experiments,both in soil and in fabrics,strong emulsions of cultures of the bacillus were used. In one case only was a typhoid stool used,and in that experiment the bacilli could only be separated from the fabric on the second and ninth days.It is not quite clear what happens when a typhoid stool is placed on,or buried in,the soil without the addition of antiseptics.Under such conditions,according to Karlinski, the bacillus can be recovered after the lapse of three months. Finally,Heim states that the typhoid bacillus,when planted in milk, lived for thirty-five days;in butter,twenty-one days;and in cheese, three days. Sitz found the bacillus to retain its vitality for three days in a liquid containing 0.03 per cent.of hydrochloric acid. Strauss and Woertz found two hours' immersion in pure gastric juice, or 0.09 per cent.hydrochloric acid,sufficient to destroy it.

Experiments on Animals.

Numerous attempts have been made to communicate typhoid fever to the lower animals;and,as these have failed,we believe the bacillus typhosus to have no specific pathogenic action on animals.

Some bacteriologists claim to have succeeded in producing the disease experimentally, because, in rare instances, they have observed ulcerative processes in the intestine and a slowly progressive affection. In 1874, Birch-Hirschfield, by feeding large quantities of typhoid stools to rabbits, produced in some of them symptoms which in some respects resembled those of enteric fever. These experiments, however, were repeated by Bahrdt, upon ten rabbits, with an entirely negative result. Motchoutkovsky injected blood from typhoid patients into apes, rabbits, dogs, and cats with no better success. Walder fed to various animals both fresh and putrid discharges from typhoid patients, and blood taken from the body after death. These experiments were likewise unsuccessful. Gaffky appears to have been the first to experiment with pure cultures of the bacilli, placing them in the food of animals, and injecting them into the peritoneal cavity and subcutaneously. Five apes were fed daily, for a considerable period, with pure cultures of the bacilli, and the temperature of the animals was taken twice daily. The result was negative. Experiments upon rabbits, guinea-pigs, rats, mice, and other animals were also negative. Cornil and Babes injected pure cultures of the bacillus into the peritoneal cavity and duodenum of rabbits and guinea-pigs without success. By a series of experiments upon different animals, Fraenkel and Simmonds showed that pure cultures injected into mice and rabbits may cause the death of these animals, and that bacilli may again be obtained in pure culture from their organs. Although the symptoms produced in these animals were not those of typhoid fever, yet the fact that death was caused by the introduction of the bacilli was held to prove that the latter are pathogenic. In these experiments, pure cultures of typhoid bacilli were injected into the peritoneal cavity in 35 mice - with a fatal result in 27 cases. The results of these inoculations appear to be influenced to a considerable extent by the amount and concentration of the culture injected. In a number of cases, a dilute mixture failed to cause death; while a concentrated one, injected into the same animals later, succeeded. These facts would appear to support the theory that the fatal results are caused, not by the bacilli themselves, but by certain toxins developed by their growth in the cultures. As many as 79 rabbits were treated also in various ways. Pure cultures were injected into the intestine five times; into the subcutaneous tissue five times; and once into the lung. Inhalation of the bacilli was tried twice. All of these experiments failed. Injections into the peritoneal cavity, in 29 rabbits, caused death in but 2; and 46 injections, into a vein of the ear, gave 20 fatal results. In fatal cases, the bacilli were obtained from the spleen by culture; and they were also demonstrated microscopically in sections. The arrangement of the bacilli in groups was precisely the same as seen in the spleen in cases of typhoid fever in man. The fact that the comparatively large amount (one-third to two syringefuls) of pure culture used in these experiments caused death after an interval of a few hours up to two or three days, in only 22 out of 79 cases, indicates that the typhoid bacillus is only moderately pathogenic in rabbits. It is, however, to be remembered that differences in lesions and symptoms produced by certain bacteria in man and animals do not prove that the bacterium in question is not pathogenic in such animals. In support of this statement, Koch cites the different manifestations of disease in man and in animals produced by the anthrax and the tubercle bacilli. Germano Maurea succeeded generally in causing death in mice, in from one to three days, by means of an intraperitoneal injection of 0.1 c.c. of bouillon culture two days old. The pathological findings were similar to those in mice killed by the colon bacilli. The more quickly the animal died, the more numerous were the bacilli found in its body - as a rule, collected into the characteristic little groups within the organs. In slower cases, the bacilli could also be found both by culture and in sections, but in smaller numbers. Proliferation of the bacilli unquestionably took place in the first case, while in the second the injected bacilli were disappearing; but death resulted from their toxic action. The same thing occurs in guinea-pigs, according to Loesener, when 0.003 gm. of an agar culture, one day old, is injected into the peritoneal cavity; and also in dogs and rabbits when intravenous inoculations are made with large doses. According to a number of experimenters, subcutaneous injections of sufficient

strength cause abscesses to develop which contain pure cultures of the bacillus typhosus - especially in dogs and rabbits.Fatal poisoning can also be caused by cultures sterilised by heat or by filtration - the process corresponding to that due to infection by living bacilli.Changes in the intestinal canal are the predominating feature in these cases,as is true also of animals infected by the colon bacillus.The lymphatic system of the mucous membrane,the mesenteric nodes,and the spleen are often specially affected.Usually the body temperature rises for a short time,and then falls rapidly to subnormal in animals.Brieger,investigating as to the chemical substances which are produced by the growth of the typhoid bacillus in cultures,in a number of cases found a deliquescent basic substance,but always in mere traces.He considered this to be a ptomaine. It was fatal to guinea-pigs in from twenty-four to forty-eight hours. According to Pfeiffer,the typhoid toxins can be best demonstrated by killing fresh agar-streak cultures with chloroform vapour,or by heating to 54° C.for one hour,and using the dead bacteria for injection.Three to four milligrams represent the fatal dose for a guinea-pig weighing 100 gm.High temperatures appear to destroy the toxin. By using freshly isolated cultures of typhoid bacilli,Chantemesse and Widal claimed to have caused not only the poisoning,but also the infection of mice and guinea-pigs.Old cultures became virulent when injected subcutaneously in these animals - if at the same time a considerable quantity of sterilised streptococcus bouillon was introduced into the peritoneal cavity.Cultures from these animals required less of the sterilised streptococcus bouillon to cause death in the second animal.After being passed in this way through a series of 25 animals,the typhoid cultures became so virulent as to cause death without the aid of streptococcus bouillon.The disease so produced was septicaemic in character,and had little resemblance to human typhoid.Sanarelli also increased the virulence of typhoid bacilli by sterilised cultures of colon bacilli,as well as of the bacillus prodigiosus.Lépine and Lyonnet injected pure cultures of typhoid bacilli into a portion of the intestine of a dog,confining them in this situation,by means of ligatures,for three days.No symptoms of disease were produced.When the animal was killed,on the twentieth day,no lesion of the mucous membrane of the intestine was found,nor was the spleen increased in size.The mesenteric lymph nodes,however,were greatly swollen.The infection was general,and of the nature of a septicaemia.The blood-serum showed the characteristic reaction of Widal,in the strength of 1 to 100.It is a more difficult matter to infect or poison animals by the mouth.The experiments of the earlier writers were failures,and the later ones have given few successful results;and the latter have not been uniform.The same is true of inoculations in the intestinal canal.According to Cygnaeus,infection by inhalation seldom causes a reaction.The immunising experiments of Pfeiffer and others have demonstrated that the bacillus typhosus produces a specific effect in animals comparable to that in human beings,although differing in lesions and symptoms. Animals inoculated in the usual way,by repeated small and increasing doses of typhoid bacilli,and proof against these bacilli and their toxins;but they are not so against the colon bacilli.The reverse of this is also true.These results have been fully demonstrated by different experimenters,and are not constant.This may be considered the final proof of both the identity of the typhoid bacillus and of its specific character.Further,from animal experimentation we may conclude that typhoid bacilli are capable of proliferating in the bodies of living animals only when taken in large doses,and then only to a limited degree;also that the animals are killed by a toxin produced by the bacillus,which acts chiefly on the intestinal canal. The lesions in animals which resemble those due to the typhoid process are seen also as a result of infection by the colon bacilli. Typhoid fever,as seen in man,has not yet been satisfactorily produced in animals.Experiments with cultures given by the mouth,or by intravenous injection,have failed to give positive results,though Remlinger seems,in the case of rabbits and of white rats,to have demonstrated that typhoid fever can be communicated to animals,and by means of the casual agent of the disease.

Propagation - Contagion.

During a by no means inconsiderable period much diversity of opinion existed in regard to the contagiousness of typhoid fever. In the early part of the last century,there were quite a number of

good observers who held the opinion that it was an eminently contagious disease.At the present time,however,the vast majority of physicians,whose opportunities for observation give weight to their views,consider that the disease is not actively contagious in the sense in which scarlet fever and measles are - i.e.,there is no danger in being simply in the immediate presence of a typhoid patient.Other patients in the same ward with typhoid sufferers almost never contract the disease from them.Attendants do,however,a little more frequently;and this is undoubtedly due in most instances to their handling the clothing,the bed linen,and the utensils of various kinds which have been soiled with the discharges.Yet,even such cases are rare.Murchison states that in 23 years,in which 5,988 cases were treated in the London Fever Hospital,only 17 residents contracted the disease,and most of these had no personal contact with the sick. Osler mentions that,during six years,1 nurse,1 orderly,and 1 patient took the disease in the wards of which he was in charge.

Clothing and bed linen(which have been soiled by the patient), mattresses,and utensils (such as urinals and syringes) may convey the disease to others not in immediate attendance.The statistics of the London Fever Hospital show that laundresses are more liable to contract typhoid fever than the immediate attendants upon the sick. Their liability is gravest in those cases in which the bed linen and clothes of a patient are not immediately disinfected after use.The committee of the Clinical Society concluded that typhoid infection may be conveyed by fomites,and may be retained in them probably for two months at least.

It is natural to suppose that typhoid infection may be conveyed by flies and similar insects.They carry the bacilli from the discharges,and directly infect others;or they deposit the poison on the food.Simmonds,Craig,Burgess,Hoffmann,Veeder,Sangree,and others have shown that microbes may be conveyed by flies.Many of the instances,in which people living in the same house are attacked by typhoid fever,can be explained in this way.Such a method would depend upon gross neglect of sanitation,involving the exposure of infected excreta.Under ordinary circumstances,flies practically could only become potent by carrying the infection to water,and so distributing it thereby.Apart from this,they can only give rise to sporadic cases.

Formerly,the transmission through air - either directly from the patient or from decomposing refuse,as by sewer gas or from old collections of dust - was held to be an important mode of propagation of the poison.This is now considered to be of very rare occurrence.It has been shown that dry bacilli may be suspended in the air. Some have thought that they found them in the dust of a building wherein there had been cases of typhoid fever.Others believe that the gas escaping from open drains,or air blowing over polluted soil, may have been an important factor in giving rise to the disease; but,where these unfavourable conditions exist,there are doubtless other ways than through air by means of which the bacilli may have been disseminated.

Since the time of Budd,the markedly contagious character of typhoid stools has been considered established.It is certain that the bacilli escape from the body for the most part in the faeces and urine.Since the methods of separating the bacillus typhosus from other bacteria have been improved,they have been demonstrated in the faeces in more than a half of the cases examined.Richardson found them in 10 out of 13 patients - in 19 out of 55 specimens.It has been held that typhoid bacilli may be present in the faeces of persons not suffering from typhoid fever:thus,Remlinger and Schneider claimed to have found them in 50 per cent.of non-typhoid cases.One other such case has been reported in an attendant upon typhoid fever patients.Richardson examined the faeces of non-typhoid patients during life seventeen times and post-mortem twelve times;but he was not able to discover any typhoid bacilli in them. They may remain in the gall-bladder for long after an attack.The bacilli may therefore pass into the intestines,and so be discharged from the body when there is no manifestation of the disease.The urine has also been found to contain typhoid bacilli for weeks,or even for months, after the patient's recovery.They are said to become more abundant in the faeces when the stage of sloughing in Peyer's patches arrives. They are sometimes found as early as the seventh day;and they usually disappear soon after convalescence has set in.They have been

seen forty days after the temperature had become normal.Richardson found typhoid bacilli in the urine in 9 out of 38 typhoid patients, in 44 out of 172 specimens.When found,they were in large numbers, and in nearly pure culture.They appeared first in the later stages of the attack,generally persisting far into convalescence;in 2 cases they were found ten days after the patients had been discharged from the hospital.They were nearly always associated with albuminuria and casts.

According to Budd,the sputum,in cases of typhoid fever where bronchitis is excessive,may sometimes contain the germs of the disease: he mentions a case in which they were believed to be responsible for the propagation of the disease.

The bacillus typhosus has also been found in the perspiration in certain sufferers from the disease.

The propagation of typhoid fever has been more frequently, clearly,and strikingly shown to occur by means of drinking-water than in any other way.There are a very large number of cases recorded in the literature.A few of them,showing most surely the origin of this disease from the water-supply,may be cited at this juncture:

(1) Cayley (Brit.Med.Jour.,Mar.15,1880) writes that Lausen is a village lying on the railroad between Basle and Olten,shortly before crossing the great Hauenstein Tunnel.It is situated in the Jura,in the valley of the Ergolz,and consists of 103 houses with 819 inhabitants.It was remarkably healthy,and resorted to on that account as a place of summer residence.With the exception of six houses,it was supplied with water by a spring,with two heads,which rises above the village at the southern foot of a mountain called the Stockhalder,composed of oölite.The water is received into a well-built covered resevoir,and is distributed by wooden pipes to four public fountains,whence it is drawn by the inhabitants.Six houses had an independent water-supply - five from wells,and one from the mill-dam of a public factory.On August 7,1872, 10 inhabitants of Lausen, living in different houses,were seized with typhoid fever;and during the next nine days 57 cases occurred - the only houses escaping being those six which were not supplied by the public fountains, The disease continued to spread,and in all 130 persons were attacked, as well as several children who had been sent to Lausen for the benefit of the fresh air:these fell ill after their return home. A careful investigation was made into the cuases of this epidemic,and a complete explanation was forthcoming.Separated from the valley of Ergolz,in which Lausen lies,by the Stockhalder,the mountain at the foot of which the spring supplying Lausen rises,is a side valley called the Furjust,traversed by a stream,the Furlenbach,which joins the Ergolz just below Lausen - the Stockhalder occupying the fork of the valley. The Furlenthal contains six farm houses,which were supplied with drinking water - not from the Furlenbach,but from a stream rising on the opposite side of the valley to the Stockhalder. Now,there was reason to believe that under certain circumstances water from the Furlenbach found its way from the Stockhalder into one of the heads of the fountain supplying Lausen.It was noticed that when the meadows of one side of the Furlenbach were irrigated,which was done periodically,the flow of water into the Lausen springs was increased,rendering it probable that the irrigation water percolated through the superficial strata,and found its way under the Stockhalder by subterranean channels in the limestone rock.Moreover,some years before a hole on one occasion formed close to the Furlenbach by the sinking in of the superficial strata,and the stream became diverted into it and disappeared;while shortly afterwards the spring of Lausen began to flow much more abundantly.The hole was filled up,and the Furlenbach resumed its usual course.The Furlenbach was unquestionably contaminated by the privies of adjacent farm houses:the soil pits communicated with it.Thus,from time immemorial, whenever the meadows of the Furlenthal were irrigated the contaminated water of the Furlenbach,after percolation through superficial strata and a long underground course,helped to feed one of the two heads of the fountain supplying Lausen.The natural filtration, however,which it underwent rendered it perfectly bright and clear; chemical examination showed it to be remarkably free from organic impurities;and Lausen itself was extremely healthy and free from fever. On June 10th,one of the peasants of the Furlenthal fell ill with typhoid fever,- the source of which was not clearly made out,- and

passed through a severe attack with relapses - so that he remained ill all summer;and on July 10th a girl in the same house,and in August a boy,were attacked.Their dejections were certainly - at least in part - thrown into the Furlenthal;and,moreover,the soil-pit of the privy communicated with the brook.In the middle of July,the meadows of the Furlenthal were irrigated as usual;and,within three weeks,this was followed by the outbreak at Lausen. With the object of demonstrating the connection between the water-supply of Lausen and the Furlenbach,the following experiments were performed: The hole,mentioned above as having on one occasion diverted the Furlenbach into the presumed subterranean channels under the Stockhalder, was cleared out;eighteen hundredweight of salt were poured in after being dissolved in water;and the stream again diverted into it.The next day salt was found in the spring at Lausen.Fifty pounds of wheaten flour were then poured into the hole,and the Furlenbach again diverted into it;but the spring at Lausen remained clear,and no reaction of starch could be obtained - showing that the water must have found its way under the Stockhalder,in part by percolation through the porous strata,and not by direct channels.

(2) An epidemic of typhoid fever occurred at Stuttgart in 1872. The meadows,from a portion of which the Stuttgart aqueduct receives its supply,were,in the beginning of the winter 1871-72,thickly manured with the contents of the city sewers.There was,in January, a thaw with rain;and the water of this aqueduct became of a yellow colour,with an offensive smell.This was nor produced by inorganic substances;and examination showed the presence of large quantities of organic matter.In February,an epidemic broke out in the portion of the city supplied by this aqueduct - so severe,indeed,that there happened to be,on the average,one typhoid patient for every two houses.In a neighbouring district,partly supplied with water from the same aqueduct,there was an average of one patient to every ten houses. In the rest of the city,the disease was not more frequent than at ordinary times - averaging one case to every forty-four houses.

(3) There was an epidemic of typhoid fever,in 1898,at Maidstone, in which some 1,908 cases of the disease were reported out of a total population of 35,000.Different districts of the town were supplied with water from different sources;almost all of the cases occurred in those districts receiving their water from a single source.A number of cases,it is true,occurred in that part of the town which did not receive water from this source;but this can be readily accounted for by the fact that the inhabitants did not,of course, remain in the same district,but visited in different parts of the town;and by the further fact that articles of food and other contaminated articles may have been conveyed from one district to another. The water which supplied the most severely affected portions of the town came in part from resevoirs so located as to be liable to contamination;one of them was very close to a heap of refuse where crowds of hop-pickers were in the habit of defaecating,and also to a camp of gipsies.

Ballard (On a Localised Outbreak of Typhoid Fever in Islington, London,1871) has very clearly shown milk to be a medium of communicating the disease.He found that an epidemic which occurred in the parish of Islington,London,in 1871,was (1) almost entirely confined to a district comprised within a circle having a radius of not more than a quarter of a mile; (2) that out of 62 families living within this district,who were known to have suffered from typhoid fever,54 were constantly supplied with milk from a particular dairy,and it was satisfactorily proved that at least 3 of the remaining 8 had occasionally partaken from the same source; and (3) that out of 142 families(comprising all the customers of this dairy,and living not only within the district above specified,but in other parts of the parish) 70 - or very nearly a half - were invaded with typhoid fever within the ten weeks during which the epidemic lasted.Upon a visit to the farm from which the milk came,it was ascertained that a member of the dairyman's family had been ill with typhoid fever,and that the water of the well which supplied the family with drinking-water had been polluted with his discharges.Although the dairyman denied that this water had ever been mixed with the milk,he admitted that it had been used to wash the milk-pans.

Another remarkable instance of this kind, occurring at Bristol, was studied and described by Davies - the Medical Officer of Health of that city. The location of the cases having indicated that the origin of the epidemic lay in milk coming from one place, a search was made for the source of contamination of that liquid. For a long time no explanation appeared; but it was finally ascertained that a man working in the fields, on the side of the valley from which the milk was brought, had not been well, though continuing at work. He had frequent evacuations from his bowels in the fields; and his blood gave the Widal reaction. It was ascertained also that the milk-cans were washed with water from the stream running through this valley.

In some cases oysters have been shown to be the agents conveying the typhoid bacilli: there are many interesting cases on record. Chantemesse, in 1896, reported a small outbreak of typhoid fever due to this cause; and it was in a village where there had been no case of the disease for about a year. A merchant there imported a lot of oysters, which were eaten raw by fourteen people. All of these were taken ill; while none of those living in the houses where the oysters where consumed, but had not partaken of them, were affected. No less than 8 of these 14 patients had slight gastro-intestinal attacks; 4 others were ill for about three weeks with prostration, abdominal pain, tympanitis, tenderness, and dysenteric movements; the remaining 2 had severe attacks of typhoid fever. Foote has shown that typhoid bacilli, with which oysters have been intentionally infected, may be found in them even after thirty days from the date of infection. Even in extremely cold weather, they may live in unsterilised salt water for at least eight days. In warm water they rapidly diminish in number after the first week, and cannot be detected in such after three weeks. He also showed that the bacillus typhosus lives longer in the juices and stomach of the oyster than it does in the water in which the oyster grows. Chantemesse experimented, by intentionally contaminating oysters with typhoid cultures, thereafter placing them in salt water. On removal at the end of twenty-four hours, they were found in as virulent a condition as hitherto.

Ice-cream has sometimes been the cause of an outbreak of typhoid fever. An epidemic, occurring in Mid-Renfrewshire in 1893, was evidently due, at least in part, to the use of ice-cream sold by a dealer whose daughter was sick with typhoid, but continued to work in the shop during most of her indisposition.

Other articles of food have been blamed for the occurrence of typhoid fever. Several epidemics of the disease have been reported in which the malady appears to have been caused by the use of putrefying meat, or of the flesh of diseased animals. In some of these the symptoms were rather those of irritant poisoning than of typhoid fever; and they consisted principally of violent vomiting and purging coming on very shortly after the ingestion of the unwholesome food. As typhoid fever has never been recognised in animals, it is difficult to avoid the suspicion that there may have been some other factor at work in these cases. There yet remains a certain number in which the symptoms cannot be thus explained. One of the most remarkable of these occurred at a festival which was held at Kloten, - a place about seven miles north of Zurich, - of which the following is an epitome:

Out of 690 persons who sat down to the collation, 290 were taken ill; 378 other persons, who did not attend the festival but who partook of the meat provided for it, were also affected. In addition to these, 49 secondary cases occurred - i.e., of persons who subsequently became affected without having eaten of the meat. All other sources of infection could certainly be excluded, as Kolten was quite free from typhoid fever at the time; and it was clearly shown that the water was not the cause of the outbreak. All the visitors at the festival who ate no meat escaped, as did also several persons who drank wine to excess and subsequently vomited. The period of incubation was short, as in other epidemics arising from the same cause. Some of the people were ill on the second day with loss of appetite, nausea, headache, pain and swelling of the abdomen, and slight fever. These cases were slight, and they generally ended in recovery. The greater number were affected between the fifth and the ninth days. The symptoms in these cases, which usually ran a rapid course, were

chills,fever,diarrhoea,great prostration,frequent and violent delirium,and also profuse intestinal haemorrhage.The roseolous eruption was present in almost all of them;and in a few the"taches blenâtres" (bluish spots on the skin were detected.With regard to the meat supplied,the following facts were ascertained: A butcher at Seebach furnished 42 pounds of veal taken from a calf,which appears to have been at the point of death when it was killed by him.All the flesh of the animal was sent to supply the festival at Kolten; but the liver was eaten by an inhabitant of Seebach,and he was attacked by typhoid fever also.The brain was sent to the parsonage at Seebach,and all the household became affected by the same disease. It was also found that another of the claves was diseased.The veal from this animal had been kept fourteen days,and was in a decomposed state.All the meat was placed together in the meat-safe of the inn at which the festival was held.This receptacle was in an extremely filthy condition;and Cayley (On Some Points in the Pathology and Treatment of Typhoid Fever,London,1880) thinks there can be no doubt that the putrefying flesh of this last calf,together wih the state of the meat-receptacle,would rapidly excite decomposition in the whole supply. Geissler doubts whether this epidemic was really typhoid fever;and he points out that the symptoms occurred too soon after the ingestion of the diseased meat,and reached their full development too rapidly.The cases were also accompanied by more pain in the abdomen than is generally met with intyphoid fever.The proportion of recoveries also appears to have been unusually large. Unquestionably the patients in the Kloten epidemic were in a large number of instances simply suffering from the action of an irritant poison;but the presence of the characteristic lesions of typhoid fever in some of the fatal cases renders it certain that this disease existed in the village at the same time.In the report of this epidemic it is not stated that either of the calves which furnished a part of the meat for the festival were suffering from typhoid fever at the time they were slaughtered.It is said that this animal is liable to be attacked by the disease,and that in certain cases typhoid fever has followed the ingestion of veal (Berl.klin.Woch., 1878,No.39). That it does not usually occur from this cause is believed to be probably due to the fact that the flesh of this animal is generally eaten before it has had time to acquire infective properties.

P A T H O L O G Y.

In typhoid fever the bacillus typhosus gains entrance to the system by means of the intestines after having been swallowed.For one or two weeks no effects,or only very slight ones,are produced. Sometimes the bacilli may remain alive in one or other part of the body for a long period without giving rise to important symptoms. Usually,however,in one or two weeks after their introduction,decided effects begin gradually to show themselves.The typhoid bacilli have been found in nearly every organ and fluid of the body specially examined;they escape with the urine and faeces;and they may also make their way through the placenta into the foetus.Lodging in these various parts and scattering everywhere their poisonous products, they give rise to abnormal phenomena,which same may be divided into two groups - (1) intoxication,and (2) anatomical alterations. In the majority of ordinary cases of typhoid fever the toxic effects dedidedly predominate;the local lesions and the symptoms depending directly upon these lesions play in most cases a less conspicuous part. Among the more prominent toxic manifestations of the disease are the elevation of the temperature,- characteristic in its duration and variations,- the prostration,the general pains,and the disturbances of the nervous system.The disturbance of the circulation -and probably also the distension of the abdomen - are in part effects of the intoxication.The typhoid bacilli and their products not only interfere with the functions of the organs by their poisonous action,but even cause structural changes in them. The

tissues are excited to somewhat characteristic histological changes. The smaller lymph channels,more particularly in and around nodules of lymphoid tissue,are especially sensitive to infection,and react principally in the way of cellular proliferation.This,with some congestion and inflammatory exudation,produces a marked swelling of the lymph organs,and frequently ends in such obstruction to the local circulation that necrosis results,and also a sloughing of exposed surfaces.In other cases,or in other parts of the same patient,the bacilli may have a true pyogenic power,causing suppuration in various organs and tissues.Degenerations of various kinds are also commonly produced in different organs - especially in the protoplasm of the cell bodies,as in the case of many infectious diseases.The typhoid bacilli appear to have a marked preference for certain parts of the body - viz.,the lymphoid structures of the lower end of the ileum,the mesenteric lymph nodes,and the spleen;and then the mucous membrane of the rest of the intestine (ileum),the large intestine, the jejunum,the larynx,the pharynx,the gall-bladder,and the bones. The blood-vessels and the liver are less frequently affected.The most noticeable lesions found in typhoid fever are those of Peyer's patches.They become enlarged and congested,necrotic,ulcerated,and later cicatrised.The other mucous membranes above-mentioned may show similar changes.The lymph nodes and spleen become enlarged,and the bones and their periosteum may be inflamed.Some of the blood-vessels are occluded by the proliferating endothelium,or by clots caused by these cells as they break down;and these obstructions lead to necrosis,as seen in minute foci in the liver,ulcers of various size in the mucous membrane,and gangrene in various situations.The debility and malnutrition induced by all these effects of the infection,aided by the pressure in certain parts,may cause bed-sores. These bed-sores,gangrenous areas,and ulcers furnish a ready means of entrance for pyogenic micro-organisms,causing a mixed infection with the usual manifestations of the pyaemic condition.

M O R B I D A N A T O M Y.

APPEARANCE OF THE CADAVER.

In general,rigor mortis is more marked and more prolonged than after typhus fever.Emaciation is often extreme in cases in which death has taken place after the third week - especially if they have been attended with much diarrhoea and pyrexia.No traces of the characteristic roseolous eruption are found after death - no matter how profuse it may have been during life.Sudamina,on the other hand,persist;and discolorations of the dependent parts of the body are invariably present.

NATURE OF THE LESIONS.

Typhoid differs from the other continued fevers,with the exception of cerebro-spinal fever,in the invariable presence of special pathological changes.These are so characteristic that an examination of the body after death will make known the nature of the disease - no matter whether the symptoms have been suggested or not during life.It must be remembered,however,that the intestinal lesions,as well as those of the mesenteric glands,do not constitute typhoid fever;but that the chemical poison produced by its specific cause is taken up by the fluids of the body,and gives rise to general disturbances,which are present in all fully-developed cases,and which manifest themselves at a very early period in the attack.The more important symptoms of the malady are not due to the specific lesions, but can be directly attributed to the general process.The anatomical lesions of typhoid fever can,therefore,be divided into two groups.

The first of these includes certain changes in the glands of Peyer, the solitary glands of the intestines, the spleen, and other lymphatic structures of the body. These changes, which consist essentially of a medullary infiltration of these glands, will be minutely described presently. They are peculiar to the disease, and just as characteristic of it as the condition of the lungs and their membranes found in pneumonia and pleurisy are characteristic of those diseases. They are usually most developed in grave cases; but occasionally they are slight, and but little marked, in cases in which the general symptoms are severe. Therefore, they cannot be regarded as the sole cause of the latter. It is more probable that they are themselves the result of the local action of the typhoid poison, and bear somewhat the same relation to typhoid fever that the eruption in smallpox does to that disease. The second group is made up of lesions which are met with not only in this, but in other, diseases accompanied by high fever; and are, therefore, unquestionably the result of the general process resulting from the action of the various toxic principles to which the phenomena of such diseases are due. These anatomical changes - essentially those of parenchymatous degenerations of various organs and tissues - attain their full development in typhoid fever, however, for the reason that in this disease the organism is continuously subjected to the action of those toxic principles for a considerable time.

INTESTINES.

The most remarkable changes in typhoid fever, and those which have formed the basis for its satisfactory recognition as a distinct morbid entity, are those of the lymphoid structures in the lower part of the small intestine. Peyer's patches and the solitary glands of this region, in almost every case of typhoid infection, undergo characteristic changes, as was fully demonstrated by Bretonneau. These have been usually described as passing through four stages, as follows: (1) The stage of medullary infiltration; (2) the stage of softening or sloughing; (3) the stage of ulceration; and (4) the stage of cicatrisation. These stages are said to last about a week, and correspond to certain definite periods of the disease; but it is not uncommon to find in the same intestine glands in two or more of these stages. Indeed, the same gland may sometimes be found ulcerating at one side and undergoing the cicatricial process at the other.

First Stage - Medullary Infiltration.

In this stage the agminated glands are enlarged - each Peyer's patch preserving its oblong shape, and being flattened on the surface, and elevated from half a line to two lines above the surrounding mucous membrane: from which it is separated by an abrupt border, and which it may in a few cases overhang like a fungous growth. The solitary follicles are also swollen, and may vary in size from a hempseed to a slight pea. In very severe cases all the glands may be more or less involved; but in mild cases the changes may be limited to three or four of Peyer's patches, although the solitary glands rarely wholly escape. It is uncommon also for the latter to be alone affected, but a few such cases have been reported. In these the mucous membrane appears to be studded with pustules; and hence Cruveilhier designated this variety as the "forme pustuleuse". The mucous membrane covering the affected glands is reddish-green in colour, and that in their immediate vicinity is often injected. The changes above described occur early in the disease, - Murchison has seen them, in two cases, in which death took place at the end of the first day, - and they are often well marked at the end of the third or fourth day. They are usually limited to the glands in the lower part of the ileum, the agminated glands being often found perfectly healthy four feet above the ileo-caecal valve. So, too, the changes in the solitary glands may be confined to the last twelve inches of the smaller intestine; but this is by no means universally the case, for these glands are not only often found enlarged higher up in the small intestine, but also occasionally in the caecum. The agminated glands are sometimes found enlarged in the bodies of those who have died of measles and of some other diseases; but the degree of enlargement is rarely as great as in typhoid fever, and further changes (to be described presently) are never found except in the latter affection. Under the microscope, the medullary infiltration - upon which the enlargement of the glands depends - is found to be due to proliferation of the cellular elements. In the case of the agminated glands,

this proliferation may be limited to the follicles,or it may extend to the intercellular tissue,and even to the adjacent mucous membrane. In the former case the patches have a reticulated appearance:they are soft and but little elevated.These are the "plaques molles" of Louis,and the "plaques reticulées" of Chomel.In the latter they are harder,smoother,and more elevated.To this variety Louis has given the name of "plaques dures",Chomel that of "plaques gauffrées". The morbid process is also very apt to extend from the solitary follicles to the surrounding mucous membrane.In a large number of the glands in many cases,and probably in all of them in the abortive form of the disease,the changes never advance beyond the first stage - a restoration to their normal condition taking place,according to Rindfleisch (Pathological Histology,Syd.Soc.Transl.,Vol.i,p.441), by colliquative softening.The morbid material upon which their enlargement depends breaks down into an oily débris which is gradually absorbed.This retrograde process takes place faster in the follicles than in the interfollicular tissue;and,as pigment is very apt to be deposited in the depressions thus formed,the patches acquire an appearance which has been compared to that of a recently shaved beard.This appearance,however,is not peculiar to typhoid fever,for it is met with in other affections.

Second Stage - Softening or Sloughing.

In this stage of necrosis small portions of single Peyerian patches,- varying in size from that of a lentil to from three-quarters of an inch to an inch and a quarter in diameter,- assume a yellowish-white and opaque tint instead of their former reddish and translucent appearance;gradually becoming separated from the surround-ing tissue by a sharp line of demarcation;and then pass into a state of cheesy necrosis.Here and there the same changes are observed to have taken place in the solitary glands.When once this has occurred, recovery can only take place by expulsion of the necrosed parts and consequent ulceration.Necrosis of the glands probably rarely occurs before the beginning of the second week,but it has occasionally been observed much earlier.Murchison reports a case in which he saw it as early as the first and second days.The process may extend to the muscular and even to the peritoneal coats;but it usually involves only the mucous membrane.

Third Stage - Ulceration.

The dead parts are now gradually thrown off - the process of separation usually lasting several days.At first an increased degree of congestion,followed by suppuration,is observed at the edges of the sloughs,which before their complete detachment may often acquire a yellowish,greenish,or brownish colour from the infiltration of bile.The ulcers which result correspond in size and form with the sloughs.They are,therefore,in the case of the agminated glands elliptical in shape,with their long diameter corresponding to the axis of the intestine.Their edges are swollen and overhanging,and their floor is generally formed by the deepest layer of the submucous connective tissue.They sometimes penetrate much more deeply,and may even extend to the peritoneal coat,and thus give rise to perforation of the bowel.The ulcers which result from sloughing of the solitary glands are,as a rule,small and round.Ulceration may also occur as follows: The mucous membrane becomes softened,and one or more superficial abrasions appear on the surface of the diseased patch,which extend and unite with one large ulcer;and this ulcer proceeds to various depths through the coats of the bowel,and even to complete perforation thereof.

Fourth Stage - Cicatrisation.

This usually commences with the beginning of the fourth week.The swelling of the edges of the ulcers gradually diminishes, and they become adherent to the tissues beneath.The floor of the ulcers covers itself with delicate granulations,which in course of time are converted into connective tissue.This is ultimately coated with epithelium,but neither the villi nor the glands of the mucous membrane are ever reproduced.The resulting cicatrices may be recognised by the affected parts of the bowel being thin and more translucent than in health;and they may retain these characteristics after the lapse of several years.They never give rise to contraction of the bowel.The time occupied in the cicatrisation of each ulcer is said to be about two weeks.It occasionally happens that while cicatrisation is taking place at one end of the ulcer the process of necrosis

and ulceration is still going on at the other,so that one or two ulcers may occasionally run together.The form of the ulcer may often retard recovery,and may sometimes end in perforation of the intestine,even after the patient has apparently recovered from his illness. In many cases the mucous membrane of the caecum and colon is of normal colour and consistence.In a few the membrane is paler than in health,and in others it is of an ash-gray colour.It is also sometimes injected and softened.The solitary glands are frequently enlarged and ulcerated,like those of the ileum.In the former case the mucous membranes of the large intestine throughout its whole extent - but especially that of the caecum and of the part of the colon adjacent to it - is studded with minute elevations about a line in diameter.When ulceration has occurred,the ulcers are generally round and small;but they may occasionally be oval and of considerable size.In the latter case,their long diameter will correspond with that of the circular fibres of the intestine.They have been known sometimes to be quite an inch and a half long.Flatus usually fills the colon.

MESENTERIC LYMPHATIC GLANDS.

The morbid changes of the intestine above described are constantly associated with enlargement of the mesenteric glands,which is due to cellular hyperplasia and hypertrophy of the connective tissue.This enlargement varies in different cases.In some the glands are not larger than a pea or bean;in others they may reach the size of a hen's egg.It is always more marked in the glands which lie in the angle between the lower end of the ileum and the caecum,and usually bears some proportion to the intensity of the local disease; but it is not to be regarded merely as a result of the local irritation,as it has been observed in parts of the mesentery corresponding to perfectly healthy portions of the intestine,and as the meso-colic glands have been involved in cases in which the colon was free from disease.It has,moreover,been observed in cases in which death has occurred very early in the disease;and there can,therefore,be no doubt that it is as much the result of the infective process as of the infiltration of Peyer's patches.In addition to being enlarged, if death has taken place before the end of the second week,the glands are hyperaemic and of a purplish colour.Later than this,when the sloughs have become detached from Peyer's patches,the swelling of the glands diminishes: they lose their colour and become pale,and if convalescence ensues,they return finally to their former healthy condition.Still,they have been seen shrivelled and pale or bluish for some time after convalescence.In other cases the substance of the glands softens,with the formation of puriform liquid.If the softening ~~only~~ involves only a small part of the glandular structure, restoration to health may take place through the absorption of this liquid.If it is more extensive,the whole of the glands may break down with the puriform liquid,which,when the patient recovers, undergoes caseous,and finally calcareous,degeneration.Occasionally a gland ruptures,and its contents escape into the peritoneal cavity, with the occurrence of death in due course.

LIVER.

The presence of minute spots of necrosis and inflammation in this organ constitutes a prominent effect of the typhoid bacilli in the system.These spots were at first spoken of as lymphoid nodules and compared to the lymphoid hyperplasia in the intestines,mesenteric glands,and spleen. In 1859,Friedrich first called attention to these minute nodules;and they were fully described by Wagner a year later. Hoffmann found them in 38 out of 250 cases,but they were probably more frequent than this.Some of these spots lie between the lobules, and consist of an increase of lymphoid and plasma cells forming large phagocytic cells.Others lie within the lobules and show similar cells,and,in addition,necrosis of these and of the liver cells. These changes have been found in other infectious diseases.The nodules are so small that few of them can be distinguished by the naked eye.There is also considerable parenchymatous degeneration of the hepatic cells,varying in degree with the stage and severity of the attack.The cells are at first filled with albuminous granules, later with fatty granules and coarse fat drops;and they may ultimately break down.The periphery pf the lobule is usually more affected

by these degenerative changes than the centre.In its gross appearance the organ is often reported intact - often as slightly changed,and often as showing distinct lesions.At first it is apt to be hyperaemic and slightly enlarged;later it becomes somewhat flabby and pale:as the result of the parenchymatous degeneration the lobular markings become less distinct.In severe and protracted cases,the degeneration may reach so high a degree that the organ becomes small, flabby,and of a grayish colour.Pyaemic deposits,embolism,and abscesses are rare lesions in this disease.

SPLEEN.

The lesions in the spleen are analogous to those which take place in the lymphatic follicles of the intestine and in the mesenteric glandsIt is almost invariably found increased in volume and to have undergone changes in consistence and colour.The degree of enlargement and other changes vary,of course,with the stage of the disease at which death has occurred.The enlargement takes place with less frequency in elderly than in young people,and is more marked at the height of the disease - the organ being then often twice or three times its normal size,and in some cases,it is said,even larger. Later,and especially during convalescence,the enlargement has generally very much diminished.During the first ten days of the disease,the spleen is generally tense and firm,engorged with blood, and dark-red in colour.Between the tenth and thirteen days,its appearance remains the same;but the organ is found to be soft and friable.During convalescence it becomes paler and firmer again;and it is often so shrunken in size that its capsule is relaxed and wrinkled.Haemorrhagic infarctions are often met with.These sometimes soften and break down into a puriform liquid,which may sometimes cause peritonitis by rupture into the peritoneal cavity.Rupture of the spleen has also sometimes occurred from mechanical violence. These changes are due in part to variations in the amount of blood, and in part to a medullary infiltration of the Malpighian corpuscles similar to that which takes place in the mesenteric and intestinal lymphoid structures.

OTHER GLANDS.

The glands in the fissure of the liver,the gastric,lumbar,and inguinal glands - and,indeed,all the lymphatic glands in the body - have occasionally been found swollen and congested;but their enlargement cannot be classed among the specific lesions of the disease,but is to be considered as merely the result of a local irritation.Thus,Jenner says that in the case of an extensive ulceration of the oesophagus which came under his observation,there was marked enlargement of the lymphatic glands of that tube.The lymphatic follicles which surround the glands at the root of the tongue and in the tonsils are often affected in the same way as the glands. In most cases,after a time the swelling disappears,but sometimes softening and rupture occur.Analogous changes have been also observed in the salivary glands and pancreas - except that,according to Hoffmann,a cellular proliferation precedes the degenerative process. Changes in the thyroid are rare.Curschmann found in 347 autopsies no case of thyroiditis;and in a large epidemic he found only 2 cases clinically.Griesinger found inflammation of the thyroid four times in 118 autopsies.Topfer found three abscesses in 927 necropsies. Walther found that in 73 cases of acute thyroiditis 40 were referable to typhoid fever.The bacillus typhosus has been found only a few times in the thyroid gland.In several other cases the pyogenic organisms have been demonstrated.Typhoid thyroiditis is more apt to occur at the beginning of convalescence or during the last week of the disease - especially where there has been a hyperplasia of the gland.Therefore,it is common in goitrous districts.Usually only a small part or a half of the organ is affected.Such cases generally recover quite satisfactorily.Compression,dislocation,or perforation of the trachea sometimes occurs as a result of the enlargement.

PHARYNX AND OESOPHAGUS.

The mucous membrane of these parts may present a perfectly healthy appearance;but occasionally it is congested,and the seat of ulcerations which are for the most part superficial.Sometimes, however,they have been found to extend to the muscular coat;but they have never been known to penetrate all the coats of these organs.

Jenner mentions one case in which there was extensive ulceration of the oesophagus;but usually the number of ulcers is not large. Murchison in a few cases found the pharyngeal mucous membrane coated with a membranous exudate,and the submucous tissues infiltrated with serum and pus.Osler and Packard refer each to a case presenting oesophageal stricture,probably due to contraction of the typhoid ulcers consequent upon their cicatrisation.

STOMACH AND SMALL INTESTINES.

The stomach and upper part of the intestinal tract present no lesions which are at all peculiar to typhoid fever.In a certain number of cases congestion,softening,and even superficial ulceration of,the mucous membrane of the stomach,and less frequently that of the duodenum,have been found.Fenwick reports death due to severe haemorrhage from a typhoid ulcer of the stomach.The mucous membrane of the jejunum and upper part of the ileum is not usually much reddened,and may be even paler than in health.In cases which have been protracted,it may be of an ash-gray or slate colour.The contents of this part of the intestinal tract,which is rarely much distended with flatus,do not differ materially in appearance or consistence from the matter which generally composes the typhoid stool.The bowels may,of course,be filled with blood in cases in which a recent haemorrhage has taken place.Invaginations of the small intestines, unaccompanied by any evidence of inflammation,are occasionally met with in the bodies of those who have died from typhoid fever.They are produced probably during the death agony;and as they occur in many other diseases,they cannot be regarded as peculiar to that under consideration.

GALL.-BLADDER.

The mucous membrane of this viscus has often been found to be the seat of ulcerations. It occasionally presents the evidences of catarrhal or membranous inflammation.The gall-bladder usually contain -s a pale watery liquid of a less density than bile.Its contents are, however,mixed with pus and shreds of false membrane when inflammation of its lining membrane has existed.The gall-bladder appears to be one of the favourite haunts of the typhoid bacilli.Gilbert and Girode found them there frequently;and Chiari believes,from a large experience,that they are usually present here in cases of typhoid fever.He examined the organ in 22 consecutive autopsies on patients who had died of this disease,and was able to demonstrate the fact in 20 of the cases.Birch-Hirschfield has had similar results.Richardson reports that a bacteriological examination of the contents of the gall-bladder was made in 3 autopsies of typhoid patients,and that the specific bacilli were found in every case.Various observers have made cultures from the contents obtained during life,on the occasion of surgical operations upon the gall-bladder,with the result that the typhoid bacilli were demonstrated in a number of cases,including some in which many months,or even years,had passed since the attack of typhoid fever.As Councilman has suggested,it is reasonable to suppose that the bacilli find their way to the gall-bladder through the liver.We know that they circulate with the blood;and the liver being commonly the seat of numerous small necrotic spots,there is an easy way of escape for the bacilli from the blood-vessels into the bile-ducts.As we know they can escape from the blood-vessels of the kidneys into the urine,it is easy to believe that they may more readily escape through the necrotic areas into the liver,and so into the gall-bladder.The bacilli are undoubtedly the principal cause of the ulcerations in the wall of that viscus and the larger bile-ducts, though other conditions - such as the presence of calculi - are undoubtedly contributing factors.It has been suggested that the typhoid bacilli may have some influence upon the production of gall-stones;but the facts already collected are not sufficient for us to form a conclusive opinion in regard to this question.The gall-bladder perhaps forms a sort of basis of operations from which the bacilli may from time to time make excursions,and so produce re-infection.The occurrence of ulcerative and membranous inflammations of the walls of the gall-bladder has lond been known to occur

LARYNX.

The mucous membrane of the larynx is sometimes found to have been the seat of catarrhal of diphtheritic inflammation,and sometimes also of ulceration.Jenner says that typhoid laryngitis,independent of pharyngitis,is extremely rare;but the German writers express a different opinion.Griesinger estimated that laryngeal ulcers were present in one-fifth of the fatal cases.Hoffmann found them twenty-eight times in 250 autopsies;and he affirms that the ulcers extended to,and involved,the cartilages in 22 out of 28 cases.They are most commonly found in the posterior wall of the larynx,and may involve the vocal cords.They are often discovered after death in cases in which their existence was not suspected during life.They were formerly supposed to be the result of typhoid infiltration of the laryngeal glands;but careful investigation has shown that they are the consequence of membranous laryngitis.

TRACHEA.

Inflammation and ulceration of the trachea are of comparatively uncommon occurrence.

LUNGS.

The lungs almost constantly present changes referable to the enfeeblement of the circulation and the blunted condition of the nervous system.Hypostasis is very frequent:it is limited to the more dependent portions of the lungs.More or less extensive lobular pneumonia, of the nature of the so-called inhalation pneumonia,is frequently present.Pulmonary oedema is common.The bronchitis sometimes takes on a putrid character;and the lobular infiltrations may,in severe cases, be transformed into a genuine gangrene.Lobar pneumonia also occurs - not only as a complication,but in certain instances at the onset of the disease,and under circumstances which render it probable that it is a prominent early localisation of the poison.For this reason the term "pneumo-typhoid" has been applied to a group of cases thus characterised.Acute miliary tuberculosis is less often a complication than a sequel of the attack.

PLEURA.

In typhoid fever involvement of the pleura is not very common. In certain cases fibrinous pleurisy and empyema occur.

NERVOUS SYSTEM.

Typhoid fever produces few and unimportant changes in the brain and its membranes - even in cases attended by severe nervous symptoms.Those most frequently found are adhesions of the dura mater to the inner surface of the cranium;injection or oedema of the pia mater;congestive oedema,and sometimes softening of the brain,and effusions at its base.The microscopic changes do not appear to have been carefully studied.It is said that the gray substance of the cortical portion of the brain and of the interior is sometimes of a yellowish-brown colour,and that diffuse yellow and blackish-brown spots in different places - especially in the corpus striatum and optic thalamus - may be observed.In such places the microscope shows a diffuse yellow colour,a deposit of small brown pigment-granules, and also - especially in the optic thalamus and corpus striatum - the ganglion-cells thickly crowded with brownish or blackish pigment-graules in such numbers as to conceal the outlines of many of the cells.These changes Hoffmann - who has specially studied them - is is inclined to place by the side of the parenchymatous degeneration of other organs. Virchow found also an unusual amount of pigment in the ganglion-cells of the sympathetic system.The lesions of peripheral neuritis have sometimes been found.

MUSCLES.

In typhoid fever the muscles often show marked alterations in structure.Their macroscopic appearances vary with the stage of the disease at which they are examined.When death takes place in the first or second week,they are usually dark-red or reddish-brown in colour,and also very dry.If it is delayed until later,they present a peculiar fawn or yellowish tint,permeating the ordinary red in patches,and veins not unlike the appearances of veined marble.Their consistence is also so much diminished that the finger may readily

be passed through them.Occasionally abscesses and haemorrhages into the muscular sheath are found;and Dauvé and Ball (L'Union Méd., 1866) report cases in which,in addition to these changes,rupture of muscles had occurred.Zenker,who was the first to call attention to them,ranged the changes seen under the microscope under two heads: : (1) granular or fatty degeneration,and (2) waxy degeneration.In the first variety,the transverse striae disappear,and the sarcolemma appears filled with a fine granular matter.In the second variety, the striated muscles become,as it were,pervaded with a coagulating material which sets,and in contracting breaks up the fibres into great numbers of short waxy-looking lumps - not unlike a certain variety of casts of the straight tubules of the kidneys.When recovery takes place,the affected fibres appear to be regenerated by a cell-growth within the sarcolemma.These changes occur in most fevers,- e.g.,typhus,smallpox,and scarlatina,- and are regarded as being due to the hyperpyrexia which is a frequent accompaniment of these diseases.Hayem,however,asserts that he has found them well marked in cases not characterised by a high temperature,and that,on the other hand,they are sometimes absent where this has been present.The waxy form of degeneration may affect all the striped muscles;but it is oftenest seen in the muscles of the tongue,the diaphragm,the abdominal wall,and the adductors of the thigh.

HEART.

In common with other muscles of the body,the heart suffers from both the forms of degeneration mentioned above;but the granular form appears to be more common than the waxy.In protracted cases it is usually much softened,and when thrown upon a plate no longer retains its form.It has usually lost its normal colour and acquired the tint described by the French authors as "feuille morte",from its resemblance to that of a faded leaf.Upon minute examination,the degeneration is found to have taken place in patches - the diseased fibres being found alongside of others which have scarcely undergone any alteration.These patches are especially common in the papillary muscles of the mitral valve - a fact which explains the occasional presence of systolic murmurs in typhoid fever.In addition to the microscopical appearances of the muscles already described, Hayem (Clinical Lectures on the Clinical Manifestation of Typhoid Fever, Parus,1875) has observed in his examinations of the heart a cellular infiltration of the connective tissue,and a proliferation of the nuclei of the muscles.These changes are sufficient in his opinion to establish the existence of myocarditis.He further mentions having found evidences of the frequent occurrence of endarteritis in the multiplication of the internal coats of the small arteries.

BLOOD-VESSELS.

Any part of the circulatory system may be attacked with especial virulence by the typhoid poison.The changes often observed in the large blood-vessels - especially the veins - are probably due to similar processes as in the case of the lymphatics.The proliferation of the cells in and beneath the endothelium,and their subsequent degeneration with consequent formation of fibrinous thrombi,afford an explanation of the thromboses which occur so frequently in the veins of typhoid patients and often in the arteries.In addition,we have the feebleness of the circulation due to the general prostration and degenerative changes in the heart;and there may be other and deleterious agents working in the same direction,where -as so frequently occurs late in typhoid fever - there is a secondary infection with pyogenic micro-organisms.Thrombosis of the large veins of the leg,with the well-known symptoms of phlegmasia alba dolens,is a common occurrence during the later stages of typhoid fever,and especially during convalescence.It sometimes comes on with an exacerbation of fever,with considerable pain in the region of the crural and iliac veins,and with redness and tenderness along these veins: from which it follows that it is not always a simple thrombosis,but depends upon - or at least is associated with - an inflammatory condition of the venous walls.The presence of Eberth's bacillus in typhoid phlebitis has not been satisfactorily established as a regular occurrence.Pyogenic cocci have been observed.This accident commonly occurs during convalescence.As is the case in other infectious diseases,- such as puerperal fever,pneumonia,septicaemia, pyaemia,tuberculosis,and malarial fever,- venous thrombosis occurs

most frequently in the lower extremities,and more frequently in the left leg than in the right.Next to the pulmonary and saphenous veins,the popliteal and tibial veins follow in frequency.Phlebitis and periphlebitis have been seen in old typhoid cases in old varicose dilatations of the crural veins.It is occasionally seen also in other parts of the body,as in the subclavian and axillary veins. The thrombosis may extend from the pulmonary into the iliac and vena cava,and even into the right artery.Death follows in the latter case,and may be caused by embolism of one of the main pulmonary arteries,or of one of the cerebral arteries.Venous thrombosis may also have some influence in producing gangrene of various superficial parts;but it is much more commonly produced by arterial changes. This venous complication is often distressing to the patient,and usually greatly prolongs the convalescence: it may impair the usefulness of the limb for a considerable time,but usually ends in recovery without serious consequences.The arteries are much less frequently affected than the veins,but their affection is more apt to lead to serious consequences- especially gangrene.Typhoid gangrene is most frequently seen in the lower extremities,and usually on one side only.It may be confined to the toes,or may involve large parts of the limbs.In the upper limbs the lesion is extremely rare,though it is sometimes seen there,and may involve other superficial parts - as about the neck,mouth,and the genitals.The female genitals are more apt to sufferthan the male; there may be extensive destruction of tissue opening the urethra,the bladder,or the rectum,or lighting up a peritonitis.

BLOOD.

The erythrocytes or red blood-corpuscles show a gradual decrease in number during the course of the fever,and may present the alterations commonly found in secondary anaemias;the haemoglobin falls at the same time - but to a greater extent,and reaches the normal more slowly.The degree of anaemia is,in general,proportional to the severity of the case,and may endanger life.The most striking feature of the blood,however,is the absence of any increase in the number of leucocytes.Exceptions are extremely rare,save in the case of complications;and the number is often considerably diminished. Complicated cases may show an increase in the number of leucocytes. Cabot refers to the following cases: One in which a perforation raised the number from 8,300 to 24,000; another case of perforation in which the number at the time of the accident was 18,600; a case of phlebitis in which the number was raised from 6,400 to 12,900, falling in one week later to 10,100;another case of phlebitis in which the number rose from 4,800 6,200; a case of mastoid abscess in which the number rose from 5,300 to 16,400; a case of otitis media in which the number rose from 7,200 to 14,000; a case of abscess in the buttock in which the number rose from 8,000 to 11,200; and a case of haemorrhage in which the number rose from 8,000 to 11,300. Cabot says that general bronchitis has usually no effect in augmenting the leucocyte count,unless this disease invades the smallest tubes;and he affirms also that cystitis had no effect in two cases: indeed,he is of the opinion that the complications directly due to the bacillus typhosus - such as cystitis and pneumonia - do not raise the number of leucocytes.In case of general exhaustion,a complication may fail to produce any leucocytosis;and, on the other hand,leucocytosis is occasionally seen where it is impossible to make out the presence of any complication.In such cases,however,the possibility of a secondary infection,an osteomyelitis or a phlebitis of internal veins,cannot be positively excluded.Thepolymorpho-nuclear leucocytes gradually diminish (in the latter part of the illness perhaps falling below 50 per cent.),and the lymphocytes increase in number.Eberth's bacillus has been found by culture in the blood - but usually only a few of the severe cases.Missul reports that he found the typhoid bacilli in each of the 9 cases examined.Kühnau - using from 5 to 10 c.c.of blood for each culture - found the specific bacillus in 10 out of 41 cases. Almquist and Sevestrini found them only occasionally.Bloch obtained them in 1 out of 7 cases.Fraenkel,Simmonds,Lugatello,Seitz and Gaffky failed in their attempts to isolate them from the blood. According to Cabot,with the exception of Kühnau,other observers have been successful in only 7 cases out of 176 examined.Neuhaus and

Ruetmeyer claim to have found the bacilli in the blood obtained by puncturing the rose-spots,and Neuhaus in 9 out of 15;but Fraenkel, Simmonds,Seitz,Lugatello,Gaffky,Janowski,and Curschmann obtained negative results.From blood taken during life from the spleen, Chantemesse and Widal,as well as many others,have succeeded in obtaining growths of the bacilli,though some other bacteriologists have failed in this.The bacilli have been found in large numbers in the contents of the thoracic duct,giving rise to the suspicion that this is the principal channel by which they find their way from the intestines into the blood.Having once entered the blood,however, they are carried to the various organs and tissues of the body,and escape into the urine through the kidneys;and into the lumen of the intestine by the breaking down of the lymphoid structures in its wall.In the latter part of typhoid fever especially,the blood occasionally contains pyogenic micro-organisms.

KIDNEYS.

These organs are sometimes pale and flabby,and sometimes engorged with blood.Under the microscope the appearances are similar to those described as occurring in the liver,and it is therefore unnecessary to refer to them more fully here.As a rule,the epithelium becomes granular earlier,and to a marked degree,in the cortical than in the tubular portion.The absence of albuminuria must not always be accepted as a proof of a healthy condition of the kidneys,as this symptom has been wholly wanting in cases in which the organs have been the seat of disease.Changes in the rest of the urinary tract are less common,though pyelitis and cystitis occasionally occur. In some of these cases typhoid bacilli have been found in the urine. Inflammations of these parts may be suppurative or diphtheritic; and suppuration and perforation of the bladder have also been known to occur under these circumstances.

EARS.

The ears may become affected by an extension of pharyngeal catarrh up the Eustachian tubes.Therefore,the tympanic cavity may be the seat of inflammation;and this may be catarrhal,suppurative,or diphtheritic.Otitis media was found by Hengst in 28 out of 1,228 cases.Benzold found a disturbance of hearing in 50 out of 1,243 cases.Buerkner attributed 1.8 per cent.of all cases of deafness to typhoid fever;Kramer,2.5 per cent.;and Zaufal,0.7 per cent.Aural complications occur most commonly in the second or fourth week of typhoid fever.The bacteria producing them are generally pyogenic, but in a few cases the bacillus typhosus has been found.Suppurative otitis media may go on to perforation of the tympanic membrane,or to suppuration of the mastoid cells and of the adjacent structures,or of neighbouring parts.

BONES AND JOINTS.

The typhoid bacilli have frequently been found in great numbers in the medulla of the bones,and in the inflammatory products of their lesions.They have been found lurking here for many years after the febrile attack,and associated with more or less interrupted symptoms of trouble in and about the bones.Ponfick and Mallory found changes in the medulla which resembled the characteristic typhoid lesions in the lymphoid structures of the intestines, mesentery,and spleen.The lesions are most commonly periostitis with resulting necrosis and abscess.They have been classified by Keen as follows: Necrosis in 85 cases;caries in 13;periostitis in 110; ostitis in 12;osteomyelitis in 10;exostosis in 1;granuloma in 2;and uncertain in 4. In certain cases the trouble is not extensive and subsides without any permanent injury.Besides abscesses and necrosis of the bones,perforation into a joint may occur.The osseous complications usually appear late in the disease,and often have appeared long after convalescence had apparently been established.The long bones,especially the femur and the tibia,are most frequently attacked:occasionally the ribs and sternum.It is especially apt to attack young people near the age of puberty.There may be one spot of such trouble,or it may be scattered in various parts of the body.In young children it more often begins in the region of the epiphysis. The evidence so far collected strongly points to the view that suppuration in the bone is usually due to the typhoid bacillus;but there are cases of mixed infection.These inflammations occasionally occur at the site of old lesions,and cases have been observed in

which long after the attack of typhoid fever a periosteal inflammation was set up as an immediate result of injury. In some cases the typhoid bacilli have been cultivated; and it seems probable that the bodies of those convalescent from the disease may for a considerable time contain foci of the bacilli, which may never produce further trouble, or after some injury light up an inflammation. Typhoid affections of the joints may be of three kinds: proper typhoid, rheumatic, and septic. Typhoid arthritis proper may be limited to one joint, or may affect several. The lower extremities are more frequently involved than the upper, and especially the hip-joint; suppuration rarely follows. The joint may undergo spontaneous dislocation.

SYMPTOMATOLOGY.

CLINICAL HISTORY.

INCUBATION.

The conditions under which typhoid fever occurs in large cities render it difficult, if not impossible, to arrive at a definite conclusion as to the period of incubation. Occasionally, however, the time that has intervened between the exposure to the cause and the invasion of the disease may be ascertained with precision in the outbreaks which occur in small towns, or in isolated country-houses. Under these circumstances, it has been found to vary within very wide limits. In the 3 cases related by Griesinger, the attack began the day after exposure to the infection; and, in the outbreak at the school at Chapham (referred to by Murchison), 20 out of 22 boys were seized with the disease within four days of such exposure. Other instances of a similar character are on record. In cases like these, the rapidity with which the attack follows upon exposure to the cause is doubtless due to the intensity of the poison - a view which is, to a certain extent at least, supported by the fact that the invasion of the disease under these circumstances is very apt to be abrupt: the attack being very often ushered in with vomiting and purging, or with grave cerebral symptoms. Sometimes, indeed, the gastro-intestinal symptoms have been so violent as to have given rise to the suppicion of poisoning. In the majority of cases, however, the period of incubation is probably very much longer than in those above referred to. In the celebrated epidemic which occurred, in 1872, at Lausen in Switzerland (Cayley, - Brit.Med.Jour., Mar.15,1880), the first 10 patients were attacked within three weeks of the time when contamination of the spring which supplied the village must have taken place; and these 10 cases were followed in the course of nine days by 57 others. In the town of Over Darwen, 1,500 persons were seized with typhoid fever within three weeks after a patient suffering with this disease was brought to a particular house, the sewage of which was allowed to soak into the ground through which the water-supply pipes of the town passed, and at a point where they were leaky. Lothholz observed, in an epidemic which occurred in the neighbourhood of Jena, that the average period of incubation was three weeks, the shortest period eighteen days, and the longest twenty-eight days. Haegler found, in three cases, produced by contaminated water, a period of at least three weeks. There are, however, epidemics on record in which the period of incubation was under two weeks, as for instance, that of Basle, in which a few persons were attacked who had only been in the city from seven to fourteen days. Cayley also refers to localised outbreaks of the disease, as those of Bunney and Calne, in which persons were attacked within fourteen days of their exposure to the cause. Müller (Neue Beit.z.Aetiol.des Unterleibs-Typhus, Posen, 1878), of Posen, says that the average period

of incubation of the disease is fourteen days;that it may not be more than ten days;or,on the other hand,as long as from three to four weeks;and that he has known a case in which it was thirty-four days.Murchison believed that it was commonly about two weeks; and Budd found it to vary from ten to fourteen days in a very large number of cases carefully observed. From this review of the opinions of various authors the conclusion would seem to be justifiable that the period of incubation in typhoid fever is usually between two and three weeks;but that in many cases it does not exceed ten days,and in rare cases has unquestionably been very much less.On the other hand,there are authentic cases on record in which it is said to have reached,or even exceeded,twenty-eight days in its duration.

DEVELOPMENT AND PROGRESS.

Invasion.

The invasion of typhoid fever is usually so gradual that it is often impossible to obtain exact information from patients as to the time of the commencement of their illness. The patient feels languid,and disinclined for physical or mental exertion. he has headache,and pains in the back and legs,as well as a general sense of weariness.His appetite is impaired,and his sleep restless,or it may be disturbed with unpleasant dreams. There may be nausea,or even vomiting;and either diarrhoea or constipation may be present. There is seldom a decided chill;but the patient may complain of sensations of chilliness or slight feverishness. These minor symptoms are usually classed as prodromes,and assigned to the stage of incubation.The patient,as a rule,does not feel inclined to go to bed;and he often keeps at work in spite of his indisposition for exertion.As his malaise increases,however,he seeks medical aid;and the thermometer then usually shows a degree or more of fever: the illness may now be said to have begun in earnest. It is only very seldom that the disease begins suddenly without any prodromes. In such cases it may happen that the first symptom of the disease is a chill,followed by a rapid rise of temperature to 104° F.or beyond.

First Weeks

The onset of the disease may be dated from the time that a decided elevation of temperature occurs.With the advent of fever, the patient begins to feel really ill.His weakness increases from day to day;his appetite is lost;and he complains of constant thirst and headache. The tongue is coated with a white fur - except the edges and tip,which are red;and there may be slight epistaxis. There is often diarrhoea - especially if a cathartic has been given at the beginning of the illness. Some patients suffer from deafness and ringing in the ears.In many cases the disease begins with a cough and bronchitic symptoms.The spleen is usually enlarged,and can often be detected by palpation.The temperature continues to rise steadily,being a degree or more higher each evening than on the evening before: until,towards the end of the week from the day of onset,it reaches 103° or 104° or even 105° F. The pulse-rate is quickened,but not always in proportion to the fever.It ranges from 90 to 110,and is soft and sometimes dicrotic,even at this early period.The patient feels tired,and is usually obliged to remain in bed: if he stands up,he feels dizzy and unsteady on his limbs.

Second Week.

The symptoms now undergo aggravation and have others added to them.With only slight variations,the temperature each evening maintains the maximum height reached at the end of the first week,remitting in the morning a degree to a degree and a half - the remissions being less marked in severe cases.There is less complaint of headache - the patients becoming apathetic, somnolent,and more or less delirious,especially at night.The face looks dull,the tongue is tremulous,and the prostration of the patient marked.Bronchitis is usually present,and the cough may be very distressing.There is more or less tympanitic distension of the abdomen,with tenderness on pressure in the right iliac fossa. There is usually diarrhoea - the patient having from two to six loose motions in the twenty-four hours. In some cases,however,there is constipation from the beginning to the end of the disease. Between the seventh and twelfth days the characteristic eruption

appears.This consists of small,circular,elevated,rose-red spots disappearing on pressure.They are usually developed in successive crops.The skin is hot and dry,the face is flushed,sometimes livid. He may perspire freely,especially at night;and sudamina may be observed.

Third and Fourth Weeks.

In cases of moderate severity,the symptoms begin to improve considerably,commencing with the fourteenth to the sixteenth day.Improvement is usually first manifested by the temperature. The morning remissions become more and more decided,though the evening rise continues for several days.Soon,however,the fever declines in the evening also;and towards the middle of the fourth week - or towards its end - the temperature is normal both in the morning and evening.With the decline of the temperature the general symptoms almost always improve. The tongue grows moist and tends to become clean,and the appetite returns.The patient sleeps soundly,and awakes with a clear mind.His strength also returns gradually,though convalescence is slow - even in mild cases - and may be interrupted by complications.Occasionally also,after perhaps a week or more of normal temperature,the fever may return, and the patient has a relapse attended with all or most of the symptoms of the original attack - though usually in a milder form. The fever in severe cases fails to decline during the third week. The usual morning remissions may be less marked,and the patient shows the effect of the continued high temperature and the prolonged toxaemia.The apathy and somnolence increase during the day,and the delirium at night becomes more severe and more active.In some patients delirium predominates by day as well as by night,and they require constant watching and restraint.In the intervals of active delirium the patient lies motionless in bed - sometimes muttering to himself,and quite oblivious of his surroundings.He asks for nothing,but will drink of milk or water if put to his lips.The tongue becomes dry and brown and covered with sordes,or red and glazed in appearance.The lips are dry and cracked,and the teeth also collect sordes unless carefully looked after.The face is dull and care-worn.The urine and faeces may be passed involuntarily. The abdominal symptoms also become more marked.The tympanitic distension increases,and the diarrhoea is usually profuse.The pulse is rapid and weak.The first sound of the heart grows feeble. The bronchitic signs increase,and the catarrh may extend to the smaller tubes.All these symptoms may continue into the fourth week, and then diminish;so that the patient slowly recovers.Or,again, various complications - to be described later - may arise and prolong the disease,or occasion the death of the patient.In some cases death results from simple exhaustion or cardiac failure. There may also be intestinal haemorrhage,or perforation of the bowels with resulting peritonitis and collapse.The cases which are severe from the outset may present all the above symptoms - even as early as the second week of the disease.

CONSIDERATION OF THE PRINCIPAL SYMPTOMS.

PHYSIOGNOMY.

From the beginning of the attack of typhoid fever the face has a listless and languid expression,although the eyes are usually bright and the pupils dilated. In mild cases no further alteration of the expression of the countenance than this may be noticeable during the whole course of the disease;but,in grave cases when the so-called typhoid state is fully developed,the expression becomes dull and heavy.There is,however,never the general suffusion of the face seen in typhus.On the contrary,the face is often pallid,or there is at most a circumscribed flush on one or both cheeks,which is most marked during the exacerbations of fever or after the administration of food or stimulants.

TEMPERATURE.

The temperature-curve in typhoid fever is one of the most characteristic features of the disease.It often allows of a diagnosis when other symptoms are absent;it is also of great importance in prognosis;and furnishes valuable indications for treatment.

Wunderlich and others,from a study of a large number of cases,have discovered that the pyrexia has certain characteristics which distinguish it from that of other fevers,and which,being present, in a case in which the other symptoms are obscure or ill-defined, will often enable one to recognise its true nature. The course of the fever may be divided into three periods each having its own peculiarities.It is usually said that each period lasts about a week; but,in severe cases,the second and third periods extend over a longer time than this,and the occurrence of a complication,or of any other disturbing influence,will have its effect in producing either a prolongation of any one or more of these periods,and especially of the last two,or an unwonted elevation or fall of temperature.During the first period there is a progressive rise of temperature;but the rise is never so abrupt as in typhus and certain other diseases.As there are morning remissions,- ranging from a degree to two degrees in extent,corresponding to the morning fall in the daily variations of temperature,- the tracing upon the temperature-chart will be a zig-zag or staircase line - each evening temperature being from a degree and a half to two degrees higher than that of the preceding evening,while the same difference will be observed in the morning temperature.The temperature ought, therefore,never in an uncomplicated case to be much over 100° on the first evening,or 102° F. on the second. A temperature of 104°F.at any time during the first or second day will consequently exclude typhoid fever from the diagnosis.From six to eight days are usually occupied before the maximum is reached.It has been seen to be attained as early as the fourth day in mild cases,and,on the other hand,not until much later in severe ones.It is usually 104° or 105° F., but will,of course,vary with the gravity of the other symptoms. The temperature rarely rises higher than 106° at this period.On the other hand,cases occur in which it never exceeds 103° F. during the whole duration of the disease;and it would,therefore,be wrong to exclude typhoid fever from the diagnosis,as Wunderlich does,if this temperature is not reached by the sixth day,or the eighth day at the latest.The temperature usually ceases to rise in the next period,but has a tendency to oscillate about the maximum temperature of the previous period at a fixed point,occasionally not quite reaching it,or at other times rising a little above it.The morning remissions,too,become less decided.In other words,the fever now becomes continuous.This period,although usually lasting about a week,may extend over more than two weeks,even in the absence of complications,in cases which run a severe course;and when it is prolonged from this cause,the temperature may again show a tendency to rise,and may even attain an elevation considerably above that of the preceding period.The prognosis in all such cases in which the temperature rises after the middle of the second week is grave. Temperatures of 108° or even of 110° F.have been recorded at this time.Death invariably follows such high temperatures as these;but before death actually occurs,a considerable fall of temperature very often takes place.Wunderlich has also called attention to the fact that it is not uncommon for a sudden and temporary remission of temperature to take place at this stage,varying from one degree to two degrees and a half,which may last from ten to twelve hours,and which usually has occurred in his experience from the sixteenth to the eighteenth day.Towards the close of the second period,the morning remissions will be observed to be more decided,while the evening temperature remains about the same as before.The beginning of the third period is indicated by a diminution of the evening exacerbation,while the morning remissions become still more marked. The diminution is progressive,but slow - the temperature each evening falling short by from half a degree to a degree of the point it reached the preceding evening.The morning remissions,on the other hand,each day become greater - a fall of three and a half degrees being not uncommon.The lysis,therefore,occupies usually a longer time than was required by the pyrexia in reaching its maximum.Towards the close of this period,the morning temperatures may be normal,and even subnormal,while an elevation of temperature may continue to take place in the evening.Occasionally,however,an abrupt defervescence takes place.The duration of this period will be very much prolonged if complications are present,or if the intestinal ulcers are slow in healing.It may last for more than three weeks.During convalescence the temperature is frequently subnormal even in the evening,but the slightest cause is often

sufficient to produce a considerable,though temporary,elevation of temperature.Thus,it may rise from 99° to 105.6° in a few hours - in consequence of an indiscretion in diet;or,again,from 100° to 104° F. from the suffering and excitement caused by a severe attack of toothache.Dietetic indiscretions are a prolific source of these recrudescences of fever.The fever of the third period has all the characters of an irritative fever,and is probably kept up by the irritation arising from the intestinal ulcers.On the other hand, that of the first two periods is due to the action of the specific poison upon the nervous system and the other tissues of the body. The febrile movement,however,rarely follows a perfectly typical course;and very few temperature-charts will bear,except during the first period,anything more than a general resemblance to the chart which Wunderlich has prepared as typical.A very slight cause will exercise,as has already been said,a disturbing influence upon the course of the fever;and serious complications or accidents will obviously produce a still more marked effect.An intestinal haemorrhage,for example,will cause a rapid and decided fall of temperature - even from,say,104° to normal or below it.This depression,unless the bleeding continues and the case ends fatally in the course of a few hours,is only temporary - the temperature rising within twenty-four hours to its former height or even beyond it.A free epistaxis or a copious diarrhoea will,in the same way,cause a fall of the temperature;but it is rarely so marked as in the preceding case.The same effect will be produced by the administration of a large dose of quinine,or by the application of cold water - either in the form of the bath,the douche,or any other method - to the surface of the body.On the other hand,the occurrence of a complication will cause a rise of temperature considerably above the maximum of the first period.The thermometer should be used at least twice daily.It is in this country generally introduced into the axilla,and less frequently into the mouth,for the purpose of making an observation.In other countries it is not infrequently inserted into the rectum,and even into the vagina.The temperature should be taken about 8 o'clock in the morning and the same hour in the evening,in order to secure reliable registrations.

SKIN.

The external integument is dry as well as warm in typhoid fever - the warmth varying with the pyrexia.But,on the whole,perspiration occurs with greater frequency in this disease than in any other acute affection,unless it be rheumatism.It takes place most commonly at night after the evening exacerbation,or in the morning when the patient awakes from sleep;but it is not very rare to find the skin clammy at other times.The sweating is usually general;but in a few cases it is local only.When colliquative,it is frequently exhausting,and is then a grave symptom.It is sometimes prolonged into convalescence - when it is not only annoying,but in consequence of the prostration it induces,it may delay the recovery of the patient. The present writer has not been able to satisfy himself that any peculiar odour is given off by the skin in typhoid fever; and most other observers affirm to the same effect.Chomel,however, asserted that the perspiration has a strong odour of an acid character;and Bartlett agreed with Nathan Smith in thinking that typhoid patients exhale a peculiar smell - not pungent and ammoniacal like that of typhus,but of a musty and almost cadaverous character. During the later stages of severe and fatal cases,this is said to be especially noticeable.

The Roseolous Eruption.

The exanthem in typhoid fever is characteristic,and its study is second only in importance to that of the temperature. Indeed,in many cases,without it diagnosis would be impossible.It is rarely absent in a well-developed case;but occasionally no eruption is to be found,even on careful examination and repeated search. From an analysis of the figures of various observers,it appears that the eruption is absent in about 20 per cent.of all cases.It is most frequently present in those between the ages of ten and thirty years - being absent in only 10 per cent.of such.In cases under the age of ten,the eruption was not found in about 22 per cent.In cases over the age of thirty it was absent in 16 per cent. The eruption consists of rose-coloured spots,slightly elevated above the surface, circular in form,or nearly so,having well-defined margins,usually

about a line in diameter,but sometimes varying from half a line to two or even three lines in diameter,and disappearing on pressure,to return when the latter is removed.They are generally first observed some time between the seventh and fourteenth days;but cases are on record - especially in children - in which they are said to have appeared much earlier,and others in which they could not be discovered until the twentieth day.In the latter cases,however,it is not improbable they had really been present at an earlier period,but had escaped detection.The eruption occurs in successive crops at intervals of three or four days,each spot lasting from three to five days, and the whole duration of the exanthem being usually from ten to twenty,and varying,of course,with the severity of the attack.It may continue to appear as late as the twentieth day,and in cases of relapse very much later.Spots are sometimes seen upon the abdomen, or elsewhere,after the subsidence of the fever;and whenever seen, they indicate that the diseased process is not at an end.They are usually scattered over the lower part of the front of the chest and abdomen;but also not infrequently they are met with upon the back; and if they are not found upon the abdomen,the patient should be gently turned upon his side,and this part of the body carefully examined.When very abundant,they are often also seen upon the extremities,and occasionally upon the face.They have,moreover,been seen in abundance on the upper and inner part of the thigh,and confined to that locality.When tardy in making their appearance,they may often be brought out by the application of a mustard blister,or by that of heat in any form;and it is probable,therefore,- owing,in a large measure,to the warmth of the bed,- that they are so often so fully developed upon the back.In numbers they may very from two or three to several hundred.In one case Murchison counted a thousand; and the body has been seen so thickly covered by spots of an unusually large size as to give the disease a marked resemblance to typhus fever.When very numerous,the edges of two or three of the spots may run together - giving the eruption an irregular character. No relation between the copiousness of the rash and the severity of the disease has ever been established.While the prevailing impression, therefore,that in cases in which the eruption is freely developed are apt to be of a mild character,is true in many instances,it is by no means so in all.The spots disappear after death,and are rarely converted into petechiae; but in bad cases purpuric spots have been seen,and even vibices developed independent of them. They are said to be most common in patients of an haemorrhagic diathesis.Sometimes the appearance of the eruption is preceded for a day or two by a diffuse erythema,which same may cover the entire body.When it occurs in association with a sore-throat,it is apt to be mistaken for scarlatina.Murchison has seen it persist throughout the fever,to which,however,it is not peculiar as it is seen in other diseases.

Sudamina - so called from their resemblance to drops of perspiration - occur not infrequently in typhoid fever.Murchison found them in one-third of his cases.They are minute vesicles,often not larger than a pin's head,but sometimes two lines in diameter,and occasionally(in cases in which two or three have coalesced) much larger.They usually at first contain a clear serum,which may, however,subsequently become turbid,and when very minute must,in consequence of their translucency,be viewed obliquely in order to be appreciated.Frequently,when they cannot be distinguished by the eye, they are readily detected by the touch.They rarely occur before the twelfth day,and not often before the close of the third week.Their most usual seat is the neck,the folds of the axilla,and the groin; but there is no part of the body,except the face,in which they may not occur.They are most frequently seen in those cases attended by profuse sweating,and are by no means peculiar to typhoid fever (they were thought by Louis to be specific of the disease),but are met with in other affections - as,for instance,acute rheumatism - which are attended by this symptom.They are generally followed by desquamation of the cuticle of the parts of the body most affected in this way.

Spots of a pale blue colour,and of varying size and form,are occasionally observed upon the skin in typhoid fever.The French have designated them as the "taches blenatres" They are of an irregularly rounded form,and from three to eight lines in diameter.They are not in the least elevated above the skin,and do not disappear on pressure

They have a uniform tint throughout their extent,and they never pass through the successive stages observed in connection with the rash of typhus.Two or three of them are sometimes confluent.They often follow the course of the small subcutaneous veins,and are most commonly found on the abdomen,the back,and the thighs.They are met with in other diseases,and are supposed to be due to pediculi.

Apart from the development of sudamina,the skin may undergo desquamation in fine branny scales. The hair is very apt to fall out after an attack of typhoid fever.The nails suffer in their nutrition in common with other parts of the body - a fact which may be recognised by the peculiar markings which are often found on them after the patient has recovered from his illness.

CIRCULATORY SYSTEM.

From the beginning of an attack of typhoid fever the pulse usually undergoes acceleration.This in degree is commonly proportional to the severity of the other symptoms (especially to the elevation of the temperature),and is generally more marked in the evening than in the morning.It is subject,however,to numerous variations - not only in different cases,but even in the same case from day to day, and even from hour to hour.Murchison refers to a case in which the pulse sank to 37,and never exceeded 56,during the fever,although it rose to 66 during the convalescence.A comparatively infrequent pulse may coexist with a high temperature.As a rule,the pulse is more frequent in cases which terminate in recovery;but to this rule there are numerous exceptions. In 8 of Louis's cases it never went above 90,and it seldom exceeds 100.On the other hand,in mild cases the pulse may be exceedingly frequent,reaching,and even exceeding,in many cases 120.When the disease is prolonged and the prostration is extreme,a pulse of from 140 to 150 is not uncommon. During convalescence the pulse usually gradually diminishes in frequency,and may sometimes fall below the normal standard.In other cases,on the contrary,the pulse continues frequent during convalescence,or readily becomes so after a slight exertion or excitement of any kind.A slow pulse during convalescence appears to be most frequent in men whose health previous to the attack was good,and a quick pulse in women and and delicate men.The pulse retains its frequency as long as ever convalescence is retarded by a complication.The pulse will,of course,present other changes then these.It is in the beginning firm and full,but after the first week becomes firm and compressible,and acquires the peculiarity known as reduplication.Sometimes when this is not well developed,it will be rendered quite distinct by elevating the patient's arm.Irregularity or intermission of the pulse,although not commonly observed in this disease,occasionally occurs.

The action of the heart will also be observed to grow feeble in the course of severe cases,and its first sound indistinct;but neither of these changes is so marked in typhoid as in typhus fever. Hayem says that in a certain number of cases a systolic bellows murmur,with its point of greatest intensity at the apex,is heard during the course,of at the close,of the second week.This murmur is sometimes soft in the beginning,but becomes harsh and intense later, or may have these characteristics from the start to such a degree as to give rise to the suspicion of endocarditis.An anaemic murmur is frequently present during convalescence.

RESPIRATORY SYSTEM.

The respiration is usually accelerated in typhoid fever - just as in all febrile conditions - independently of any disease of the lungs;and its frequency is generally proportional to that of the pulse.The respiratory movements are less liable to fluctuate from day to day than the pulse;and when the latter becomes abnormally infrequent,they do not sink below the standard of health.Murchison found the pulse 42 at the same time that the respirations were 48, and that,too,in the absence of pulmonary lesions.The respiration is often,as in the case just alluded to,very much accelerated when the most careful examination of the chest will not lead to the detection of any disease therein.This is sometimes the consequence of very great tympanitis,which,by interfering with the descent of the diaphragm,gives rise to dyspnoea;but it may also occur as a purely nervous phenomenon.Bronchitis,of greater or less severity,is so constantly found in typhoid fever that it is to be regarded as a

symptom rather than as a complication of the disease.The frequency of bronchitis seems to vary greatly with the epidemic and during the course of years.Murchison found it in only 21 out of 100 cases;but in the experience of others,some signs of bronchial trouble are found in all but a very small minority of cases.Sometimes there may be only slight harshness of respiration at the base of the chest;but in a large number of cases the auscultatory signs will be sonorous, sibilant,and mucous râles.The last-mentioned may be so numerous as to lead to the disease in the beginning being mistaken for acute bronchitis or acute phthisis.

DIGESTIVE SYSTEM.

Except in mild cases,loss of appetite is one of the earliest symptoms of the disease;and it usually persists as long as the disease lasts.It is sometimes accompanied by positive loathing for food;but generally there is no difficulty in persuading the patient to take the necessary amount of nourishment.During convalescence the appetite returns,and the patient clamours for food owing to his insatiable hunger.

Thirst is usually present early in the attack,and is generally proportional to the degree of fever.As the disease progresses,it becomes less marked.

Nausea and vomiting sometimes occur at the beginning of the illness,and the patient may be regarded at first as suffering from merely a bilious attack.Murchison noted vomiting in 36 out of 100 cases,and regarded it as a favourable symptom when occurring at this stage.Later in the disease,however,it may be the first symptom of peritonitis.It may sometimes occur during convalescence and interfere very materially with the proper nutrition of the patient.The vomited matter usually consists of a greenish bilious fluid,with the food last taken amongst it.In some cases blood may be expelled from the stomach.

At the beginning of the attack the TONGUE is usually moist and coated with a thin white fur;and in mild cases it may retain these characters until the close of the illness.Even in some cases which terminate fatally in the course of the second week,the tongue - with the exception of being less moist than in health - may present no marked deviation from this appearance.Generally,however, as the disease progresses,and sometimes as early as the tenth day, it becomes very dry and brownish,and is protruded with a tremulous motion.Still later it tends to cover itself with a thick brown fur.This coating is disposed principally along the middle of the organ - leaving uncovered the edges and tip,which are very apt to be unnaturally red in colour.The bare portion at the tip is often rudely triangular in shape - a point which is regarded by Da Costa as of some importance in the diagnosis of the disease.In bad cases, however,during the course of the third week the tongue is frequently crossed by cracks and fissures,which are the cause of much discomfort to the patient;and when they are deep they may bleed and leave behind them scars which are recognisable during the remainder of his life.In other cases the tongue is dry,brown,and shrivelled,or covered with a tenacious,viscid secretion which makes its protusion a matter of considerable inconvenience.In favourable cases,as convalescence approaches the tongue regains by degrees its normal appearance.At first the only noticeable change may be that the organ is a little less dry than before.In a few days it will be observed to have become moist,and to be gradually throwing off its coating.The process is,however,a slow one,and one,moreover,subject to frequent interruption.Very often,when it seems nearly completed it will be suddenly arrested,and the tongue becomes dry and brown. Sometimes,instead of cleaning gradually,the tongue throws off its coating in large flakes,leaving the mucous membrane red and shining as if deprived of its papillary structure.It is believed by many that if the tongue when thus cleaned remains moist,convalescence might be expected,but would always be tedious.If anything happens,however,to interfere with the progress of convalescence,it not infrequently becomes dry,and coats itself over again.When the restoration to health is retarded by the continuance of diarrhoea or by the occurrence of any intercurrent affection,the tongue will often become pale and flabby,and superficial ulcerations or aphthous exudations may be found upon it.

The LIPS and TEETH are in bad cases covered with sordes,and the former are dry and cracked and bleed easily.The dryness of the lips and tongue is favoured by the tendency of the patient to breathe

through the mouth. The GUMS may become spongy and bleeding occur from them at any time.

The mucous membrane of the FAUCES is ~~of~~ reddened and covered with a tenacious secretion; swallowing may be thereby greatly impeded.

TYMPNAITIS or METEORISM is present in most cases of typhoid fever. Murchison noted it in 79 out of 100 cases. In 17 the distension was extreme, and in 7 of these death occurred; whereas, of 21 cases in which there was no tympanitis, none died. Louis noticed great meteorism in one-half of his fatal cases, but in only 7 of 88 cases which recovered. It is, as a rule, later in making its appearance than the other abdominal symptoms - showing itself usually about the end of the first or the beginning of the second week. It is generally most marked in grave cases - especially those attended by severe diarrhoea; but it has also been seen highly developed in cases in which the symptom was not present at all or but little developed. Moreover, it may vary frequently in degree at different times in the same cases, but when once present generally persists until convalescence is established or death occurs. When extreme, it may give rise to distressing dyspnoea - the descent of the diaphragm being prevented by its upward pressure.

Accompanying the tympanitis are usually GURGLING and TENDERNESS on pressure in the right iliac fossa. The former of these symptoms is most marked in cases in which diarrhoea exists, and is caused by the presence of liquid and gas in the lower part of the ileum. The tenderness is a symptom of considerable diagnostic value, as it is unquestionably due to the presence of ulcers in the same part of the intestine. It is, however, often absent in well-marked cases of typhoid fever.

ENLARGEMENT OF THE SPLEEN is a most constant symptom of typhoid fever, as of other acute infectious processes. It was noted by Halle as being present in some of his cases. It may generally be demonstrated by percussion at the end of the first week or during the first part of the second, as tympanitis has not usually developed at that period. It has not, however, often happened to the present writer to be able to feel the organ enlarged through the abdominal wall as Murchison and others assert they have been able to do. Indeed, meteorism is usually present in a sufficient degree to render this difficult. According to Murchison, the enlargement is greatest in persons under thirty years of age. It is said to be often absent in elderly persons.

One of the most frequent symptoms of the disease is DIARRHOEA - especially in very severe cases; and there are very few mild cases in which it does not occur at some period of their course. Louis noted it in all but 3 of his cases; Murchison in 93 out of 100; and Barth in 96 out of 101. It varies in different cases in its severity, in its duration, and in the time when it makes its appearance. It may be one of the earliest symptoms - presenting itself frequently on the first day, and often being the only one which causes uneasiness to the patient or his medical attendant. At other times its appearance may be postponed until the end of the first week, or even until the patient is apparently entering on his convalescence. It may be mild in the beginning, and become more severe as the disease progresses; or, after having been at first acute, may cease spontaneously in a few days. In degree it may vary from two stools to three or four, or even twenty-in the course of the twenty-four hours. It is absent in a few cases, but in many such the bowels will be found to act inordinately after a mild aperient. CONSTIPATION does, however, actually exist in a certain number of cases of typhoid fever. Murchison has known the bowels, in cases in which ~~the~~ a relapse has occurred, to be constipated in the primary attack and relaxed in the relapse. There is no relation between the severity of the diarrhoea and the extent of the local lesion. Although oftenest seen in mild cases, constipation has existed in cases in which perforation of the bowel or intestinal haemorrhage has occurred during life, or very extensive lesions have been discovered at the autopsy. The CHARACTERISTIC STOOLS of typhoid fever are of a peculiarly offensive odour, ammoniacal, and of an alkaline reaction instead of acid as in health. They are usually liquid, and resemble pea-soup in their yellow-ochre colour and consistence. Murchison says that they separate, on standing, into two layers - a superficial or supernatent fluid, and a flaky sediment; but that occasionally, instead of being watery, they are pultaceous, frothy and fermenting, and so light as to

float in water:Bartlett compares their appearance to that of new cider.They may contain blood,and when they do,they occasionally present the appearance of coffee-grounds.

INTESTINAL HAEMORRHAGE is a rather infrequent symptom of typhpid fever.It may occur as early as the fifth or sixth day,but is more common after the middle of the second week,or in the third or fourth week.In 60 cases observed by Murchison in which the haemorrhage exceeded six ounces,it began during the second week (mostly towards its close) in 8;during the third week in 28;during the fourth in 17; during the fifth in 1;during the sixth in 3;during the seventh inl; and during the eighth in 1;while in 1 case date of its occurrence is not noted.There may be a slight haemorrhage,or the bleeding may be repeated one or more times.In several of Murchison's cases it recurred after its appearance at varying intervals. The bleeding is usually of trifling amount when it occurs early in the disease;and it is due either to extreme congestion of the intestinal mucous membrane - giving rise to rupture of the capillaries,or to disintegration of the blood allowing its ready passage through the walls of the vessels.In the latter case it usually coexists with petechiae or an haemorrhage from some other part of the body - as, for instance,epistaxis or haematuria.After the middle of the second week the haemorrhage is generally the result of the laying open of a small artery - either by the detachment of a slough from one of Peyer's patches,or by the involvement of its walls in the ulcerative process.It is then often profuse,and may even reach several pints in quantity.Murchison has,however,seen profuse haemorrhage at such an early stage of the disease that it was impossible that ulceration could have taken place;It may be retained for some days in the intestine before coming away,for the blood is not always voided immediately after the occurrence of the haemorrhage.Indeed,if the amount be large the patient may die within a few hours of its occurrence without any appearance of blood externally.This is,however, rare;it is more usual for the haemorrhage to be repeated before death takes place;but the occurrence of bleeding may be suspected in such cases by the abrupt fall of temperature,sometimes below the normal,and by the extreme prostration and pallor which come on suddenly without other assignable cause.The depression of the temperature does not continue long,as,in the course of the twenty-four hours,it generally rises to its former elevation,or even exceeds it. The frequency of intestinal haemorrhage apparently varies considerably with different observers,and in different epidemics under the same observers.Murchison noted it in 58 cases out of 1,564 - or in 3.77 per cent.; Louis in 8 cases out of 134 - or in 5.9 per cent.; and Griesinger in 32 cases out of 600 - or in 5.3 per cent. Strumpell states that he saw at Leipsic,in the course of several years,45 bleedings in 472 cases - i.e.,in 9.5 per cent.In one year (1880) the percentage rose to 18.On collating the experience of various observers,it appears that haemorrhage from the bowels took place in 277 out of 4,594 cases - or in 6 per cent.It is said to be twice as frequent in women as in men.It seems to be much less common in children than in adults;for in 252 patients under fifteen years of age observed by Taupin,Rilliet,and Barthez,it occurred in 1 only.There is a considerable diversity of opinion amongst observers in regard to the importance of this symptom.Murchison lost 32 of his 60 cases.In 11 of the 32 fatal cases,the immediate cause of death was peritonitis;in 14 of the remaining 21 cases,the patients died within three days of the bleeding,and in 8 of th 14 within a few hours.Of Griesinger's 32 cases,10 terminated fatally several days after the bleeding.Many clinicians have asserted that the effect of the haemorrhage was sometimes beneficial.Chief amongst these are Graves and Trousseau.There may be occasionally a slight subsidence of the nervous symptoms upon the occurrence of an haemorrhage, consequent upon the reduction of temperature which usually accompanies it;but this relief is only temporary,and it is procured at too great an expense to be really of service to the patient.The bleeding is most frequently observed in serious cases.In 18 of Murchison's patients the antecedent symptoms were mild.In 8 others,6 of which were fatal,the bowels had been constipated up to the time of its occurrence.The blood,if voided immediately after its escape into the intestines,is generally fluid and bright red in colour.When retained for a day or two,it is passed in dark clots;and if retained longer than this,it is usually mixed with faecal matter when discharged from the bowels,and gives to the stools a tarry appearance and

consistence.It is sometimes asserted that intestinal haemorrhage has become more frequent since the introduction of the cold-bath treatment of typhoid fever.It is argued that the anaemia of the skin produced by the cold water must cause a determination of blood to the internal organs,including the bowels,and thus favour bleeding therefrom.The writer's experience goes to prove that the contrary is the case - viz.,that haemorrhages have diminished in frequency under the cold-water treatment of the disease.Nevertheless,he agrees with other practitioners that when intestinal haemorrhage does occur, it constitutes a contraindication to the use of baths in this affection.

NERVOUS SYSTEM.

The symptoms of disturbance of the nervous system are among the most important,as well as the most constant,of the clinical phenomena of typhoid fever.Although the specific anatomical lesions of the disease are located in the intestines,many a case will run its course without a single symptom referable to the abdominal organs.Instances have even been reported in which the intestinal changes have themselves been wanting,although the cases in question ended fatally. The nervous symptoms,on the other hand,are always present to a greater or less extent,even in the mildest cases.Hence the term "nervous fever" so much employed by the older writers in connection with this disease.It was formerly generally believed that these symptoms were caused by the prolonged high temperature.Under this view it was difficult to explain their presence in cases in which the pyrexia is very moderate,or even wholly wanting;and in many of these cases characterised by low temperature the nervous disturbances are very marked.The bacteriological researches of the last two decades,or so,to which we are indebted for a correct understanding of the etiology of typhoid fever,have also furnished us with a clear explanation of the nervous symptoms.It is the specific infection of the disease,the toxaemia,which is the cause of the derangements of function of the nervous system.Prolonged high temperature may also be a factor in their production,but it is not an essential one.

Headache is one of the most constant of the symptoms of typhoid fever,and often the first symptom of which the patient complains; and when not present at the beginning of the attack,it makes its appearance soon afterwards.Bartlett says it is rarely absent;Louis found it in all but 7 of his 133 cases;and Murchison noted it in 77 out of 82 cases.It is almost as common,though less severe,in mild cases as in grave ones.It sometimes persists through the attack, but oftener subsides at the close of the first week or towards the middle of the second;or the patient may cease to complain of it in consequence of the dulness which is very apt to supervene.It is usually referred to the forehead and temples,but may extend over the whole head.It is usually dull and heavy,but in a few cases is throbbing.Sometimes it is very severe,and may be paroxysmal or neuralgic in character.It has been known to be so acute as to cause the disease at its commencement to be mistaken for meningitis.

Dizziness,or vertigo,is often noted during the stage of incubation,and even later in the course of the disease.It is seldom encountered during the height of the fever,but may manifest otself again at the commencement of convalescence.

Distressing pains in the back and limbs may also occur,and in rare cases even contraction of the hands and feet.There is likewise a general aching of the whole body,with a sensation of extreme weariness.

Wakefulness at night is usually suffered from at the beginning of the illness;and it occasionally happens that this is a distressing symptom.

Often somnolence supervenes sooner or later in the course of the disease.In mild cases this symptom is late in making its appearance,and is generally slight and evanescent;but in grave cases it may come on as early as the eighth day;and when once present,it may become more profound until it deepens at last into unconsciousness. It usually persists until the occurrence of death,or of convalescence;but it may alternate with periods of delirium - the delirium being more frequent at night and somnolence by day. It is as frequent in children as in adults.Occasionally the wakefulness of the earlier stage may reappear at the beginning of the third week,and coexist with muttering delirium,or occasionally with delirium of a more violent character.It then constitutes a most unfavourable symptom -

the patient passing several days and nights in incessant agitation, until death from want of sleep carries him off.

Mental hebetude, or dullness, is present in the vast majority of cases, even in the mildest attacks of typhoid fever. It may, however, be absent in cases occasionally which run a severe course. It shows itself in the beginning by way of an indisposition to be disturbed, a slight inability to fix the thoughts, or a loss of memory. Generally the patient will be able at first, by an effort to rouse himself from this apathy; but the moment he relaxes the effort, he will lapse into his former condition. As the disease progresses, the hebetude becomes more profound, and is overcome with greater difficulty. In mild cases it may continue until the occurrence of convalescence; but it is soon lost in delirium in grave cases.

Delirium is said to be present in the majority of cases of typhoid fever. In Murchison's series of 100 cases, it was absent in only 33. Other observers have found this symptom less frequent. In the writer's experience, fully one-half of his patients passed through the attack without any delirium whatever. Probably the cold-bath treatment keeps the mental faculties unimpaired. The frequency and severity of the delirium vary with the intensity of the infection, though its absence does not always indicate a favourable termination of the disease. Of Murchison's 33 cases in which there was no delirium, death occurred in 3; whereas, of the other 67 cases, 18 were fatal. The delirium, of course, as said, varies with the severity of the other symptoms, and especially with the intensity of the fever. In its mildest form it consists of a slight confusion of ideas, which is readily dissipated by fixing the patient's attention, and is most apt to occur in the night or when he first wakes up from sleep. In other cases it is much more marked; occasionally it is violent and noisy; the patient may talk wildly and incoherently, he may break out into a paroxysm of screaming, or be possessed with a sudden terror, or he may leave the room or jump from the window. Later in the course of the disease, the active delirium subsides, and a low muttering form of the same takes its place. The latter may go on until convalescence occurs, or the patient may fall into a comatose condition and die therein. The delusions from which the patients suffer are generally connected with some event in their past life. Very often the patients insist that they are in a strange place, and beg piteously to be taken home to their friends; occasionally, in grave cases, the patient declares that there is nothing the matter with him. This, Louis was accustomed to regard as a bad symptom - having never seen a recovery after it. The delirium generally makes its appearance some time in the course of the second week; but occasionally the invasion of the disease is marked by maniacal excitement. It has been known to occur on the second or third day. Louis records 2 cases in which it was present during the first night; and Bristowe (Trans. Path. Soc., Vol. xiii) 1 case in which it was noted at that time also. It is sometimes so prominent a symptom in the beginning of an attack that the patient has been at first supposed to be affected with acute meningitis or acute mania. Motet (Arch. gén. de Méd., 1868), indeed, refers to a case in which a man was actually admitted into a lunatic asylum before the true nature of the disease became known. On the other hand, delirium may not occur until later in the disease - sometimes not before the close of the third, or even of the fourth, week, - when it may make its appearance at a time when least expected.

In cases in which there has been much mental disturbance during the febrile period, the convalescence may be marked by an impairment of intellect; and this may continue after the recovery is in other respects complete: but it is rarely a permanent condition. In some cases the moral sense appears to be weakened after an attack, and thieving propensities developed in persons of previously correct habits. Insanity may also occur during the convalescence or after recovery; but it is usually under these circumstances amenable to treatment.

From the beginning of typhoid fever there is nearly always present more or less muscular prostration. It is usually most intense in grave cases; but to this rule there are numerous exceptions. It is not rare to find patients, in whom the other symptoms are severe, able to sit up in bed, and even to rise to stool, throughout the attack. Occasionally, in mild cases, patients are not confined to bed until the occurrence of perforation. Generally, however, the prostration becomes extreme in the third and fourth weeks of the disease - the patient lying helpless on his back, unable even to turn from side to side.

Tremor is a constant symptom of typhoid fever, even in the mildest cases. A little tremulousness of the tongue when protuded may often be detected before the close of the first week. A little later the hands may be observed to tremble when held up; and still later twitchings of the tendons at the wrist may be appreciable while the pulse is being felt. When muttering delirium supervenes, this subsultus tendinum becomes constant, and extends to other parts of the body. The hands of the patient are frequently then in constant motion, either picking at the bed-clothes or at the lips or nose, - carphology, - or an aimless motion of the hands through the air. These automatic movements indicate a very profound disturbance of the nervous system, and are very unfavourable symptoms. Hiccough is cometimes observed late in grave cases, and is a bad symptom.

Even in mild cases, spasmodic contraction of various groups of muscles may occasionally be observed. It is especially frequent at the beginning of the disease. The muscles of the extremities - especially those of the legs - are oftenest affected; but those of the trunk and neck may also be involved. The head may be retracted as in meningitis; there may be a condition of torticollis, or of strabismus, early in the attack. Murchison has had patients under his care who have suffered from spasmodic constriction of the pharynx to such an extent that they could not swallow. He also reported cases in which trismus and spasm of the glottis have been present during the course of the typhoidal seizure.

ORGANS OF SPECIAL SENSE.

Vision.- During the attack of typhoid fever imperfect or perverted vision, and even visual illusions and haziness of vision, have been observed. In addition to strabismus, Murchison and Bartlett have often known photophobia present in cases characterised by active excitement. As a general rule, the pupils are widely dilated, and the conjunctiva pearly-white. When, however, stupour supervenes in bad cases, the pupils are very often contracted; and Murchison has known them under such circumstances to be as contracted as in typhus. In a few cases dilatation of the pupils has been witnessed.

Hearing.- In the early stage of the disease, ringing or buzzing noises are present in a large proportion of cases, and may sometimes persist until the disease is well advanced. Usually, however, after a few days they subside and give place to deafness. This is a very common symptom, and may affect both ears, or be confined to one. In the former case it may be due to the blunted perceptions of the patient, or to catarrh of the Eustachian tube (Trousseau), and is without special significance. Recovery without impairment of hearing is the rule. Deafness of one ear, however, is a serious condition - being due perhaps to suppurative otitis. Meningitis may be the outcome of this.

Modifications of Sensibility.- Hyperaesthesia of the skin is not a frequent symptom. Murchison noted it in 5 per cent. of his cases. He did not consider it of much importance. It may occur at any stage of the disease; it is chiefly observed in the abdomen and lower extremities; and is more frequently met with in women and children than in adult males. In some cases the skin is so sensitive that the slightest touch causes the most exquisite pain. Occasionally the tenderness over the abdomen causes the illness to be mistaken for peritonitis, from which, however, it can be distinguished readily by the coexistence of hyperaesthesia elsewhere. According to Murchison, tenderness over the spines of the cervical or dorsal vertebrae is usually present. He does not consider it of much importance. Anaesthesia of the skin may also occur, but it is certainly less common in the earlier stages than hyperaesthesia. Rilliet and Barthez regard it with alarm when occurring in children.

The sense of taste is frequently lost or perverted. This is due partly to the blunted perception of taste, and partly to the thick covering of the fauces and tongue.

Nose.- Epistaxis may occur at any stage of typhoid fever, but is most common during the period of invasion. Observers differ in regard to its frequency. Murchison noted it in only 15 out of 58 cases; and he believes that it is more common in France than elsewhere. On the other hand, Bartlett says that it is quite a common symptom. The amount of blood lost may vary from a few drops to several pints. Unless profuse, it has but little effect upon the course of the disease. Murchison has often seen patients die from its severity. In moderate amounts it occasionally relieves the early headache present.

URINE.

In typhoid fever the urine presents the general characteristics common to all acute febrile diseases. As the disease begins insidiously, the condition of the urine before the attack and during the first two or three days does not perhaps differ materially from the normal. During the latter part of the first week, the amount of water is greatly diminished - occasionally falling to one-fourth or one-sixth of the usual quantity. In the second and third weeks it increases, and at the end of the fourth week may again be normal. The amount may, however, vary from day to day, but its variations do not stand in close relation to those of the pyrexia - i.e., the thermometer may register one day 104°, and the next day 100° F., while the amount of urine voided remains the same. Still, when the temperature begins to fall permanently, it increases at once, or two or three days later. The specific gravity is usually high in almost all cases in which the urine is scanty, and may be as high as 1038. With the establishment of convalescence, the specific gravity often diminishes before the water begins to increase in quantity.

At the onset of the attack the urine is very acid: this is due to its concentration, not to an increased excretion of acid. Later it may become alkaline, and even ammoniacal. The colour of the urine is very dark from an absolute increase of the pigments.

During the fever the quantity of urea is augmented, and especially during the first week. As a general rule, the higher the temperature the greater the amount of urea excreted. Vogel once found it to go as high as 1,200 gr. in the twenty-four hours. The occurrence of inflammatory complications - such as acute pleurisy - may reduce the amount of urea, even to a point below the normal. It is not, however, influenced by the diarrhoea - hence, observes Murchison, the intestines cannot be regarded as a channel for the elimination of urea in this disease.

Uric acid is always increased early in the disease - the amount of increase being relatively greater than that of the urea; it is often three or four times the amount excreted in health. This increase takes place until about the fourteenth day, diminishing thereafter, and during convalescence falling to subnormal. Copious deposits of urates and lithates may occur at any time in the course of the illness.

The chlorides are generally diminished in typhoid fever. This diminution is partly due to a less amount of chlorides being taken with the food, and partly to the fact that large quantities of salt pass away with the stools. As the diminution cannot always be fully accounted for in this way, it would appear that it is also stored up in the body during the fever.

The sulphates may be increased in amount. The phosphates are at first slightly diminished, but later are increased. There is also a diminution of hippuric acid.

Albumin is very often present in typhoid fever. Parkes found it in 7 out of 21 cases. In 5 of these it was temporary, and entirely disappeared before the patients left the hospital. Becquerel found it in 8 out of 33 cases; Andral in only 4 out of 34 cases; and Griesinger found it commonly, though it was usually temporary. The latter met with only 4 or 5 cases in which it was never present. Kerchensteiner found albumin in a fourth part of the severe cases. Loomis reports it in 17 out of 54 cases in his wards in the New York Hospital. Osler noted a much higher percentage in the Johns Hopkins Hospital. During the six years from 1889 to 1895, 389 cases of typhoid fever were treated in the hospital, and albuminuria was noted in 303, or 78 per cent. The amount of albumin was usually small - in the majority only a trace. Albumin generally appears in the course of the second week, though sometimes as early as the first week of the disease. The albuminuria is usually of short duration, and the quantity of albumin small. The contrary would point to severity of infection.

Renal casts are sometimes seen in the urine of typhoid fever. They are usually associated with albuminuria, but sometimes not. They are usually of the hyaline and granular forms, and few in number. They generally disappear with the albuminuria, and do not necessarily add to the gravity of the case.

Sugar has not been found except in the urine of diabetic patients, who may have happened to contract typhoid fever. In these persons the sugar diminishes, and is sometimes wholly absent, during the convalescence of the fever.

Typhoid bacilli are present in the urine of a large proportion

~~a large proportion~~ of cases.According to Bouchard,they are found only in albuminous urine.Seitz found in cultures from the urinary deposit,in 7 cases,the bacillus typhosus present in 2 only.In those 2 cases the urine was albuminous,and the number of colonies obtained was proportionate to the amount of albumin.Generally speaking,typhoid bacilli are present in about 30 per cent.of all urines examined during the course of the disease.

Ehrlich's Diazo Reaction.- In 1882,Ehrlich described a reaction in the urine depending upon the presence of certain aromatic substances which form aniline colours in the presence of diazosulphobenzol.The latter is formed by the union of sulphanilic acid (amidosulphobenzol) and HNO_2.In order to obtain,a fresh solution of diazosulphobenzol,a solution of sodium nitrite must be added to a solution of sulphanalic acid containing 5 per cent.of hydrochloric acid.When the two solutions are mixed,HNO_2 is set free,and diazosulphobenzol is formed. The following solutions,therefore,are necessary for the reaction :

Solution A.:

Sulphanilic Acid	1 part.
Hydrochloric Acid(concentrated) ..	50 parts.
Distilled Water	1000 "

Solution B.:

Sodium Nitrite	1 part.
Distilled Water	200 parts.

It is advisable to keep the solutions in separate well-stoppered bottles of amber glass,and preferably in a dark place.They should be mixed as required,by combining 50 c.c.of A.and 1 c.c.of B.The sodium nitrite solution does not keep well,and should be prepared freshly at short intervals.

The test is applied by mixing equal parts of urine and the mixed reagents;quickly adding one-tenth volume of ammonia-water,and shaking.A deep cherry-red colour indicates a positive reaction;and if the reaction in question is marked,the foam will appear salmon-pink,or even deep-red in colour.A further proof of the true reaction will be the formation of a green precipitate on standing.

The chief value of the test lies in the diagnosis of typhoid fever.It is present very constantly in severe cases of the disease, with an intensity usually running parallel to the severity of the infection.The clinical value of the diazo reaction is,however, greatly lessened by several facts: (1) It often does not occur in the milder forms of typhoid fever until the acme of the disease has been reached,and at times is wholly absent in such cases. (2) It occurs in many other diseases - notably in tuberculosis,pneumonia, pleurisy,many acute fevers (measles,scarlatina,diphtheria,erysipelas, etc.),in syphilis,cancer,septicaemia,pyaemia,rheumatism,etc.In practice,the chief diseases in which it puzzles the diagnostician are tuberculosis and septicaemia.In pulmonary tuberculosis its presence is af bad prognostic import;and its persistence indicates an advanced stage of the disease. (3) The reaction occurs in the urine of persons who have been taking certain drugs - e.g.,naphthalin and chrysarobin,etc.This reaction,however,is distinguished from the true diazo reaction by the absence of a green precipitate on standing for twenty-four hours,and by the fact that the colour does not disappear on the addition of acids.The appearance of the reaction may be inhibited by other drugs - e.g.,gallic and tannic acids and their compounds iodine,and the iodides.

COMPLICATIONS AND SEQUELAE.

RESPIRATORY SYSTEM.

Laryngitis is an occasional complication of typhoid fever.When it assumes the diphtheritic form and runs on to the formation of ulcers,it is a very serious complication;for it not infrequently is accompanied by oedema of the glottis,requiring tracheotomy for its relief.It appears,however,at least in its worst forms,to be of rather rare occurrence.German physicians do not consider it at all of unusual occurrence.

The frequency with which bronchitis,in some form or other,attends upon typhoid fever has already been mentioned.When it invades the smaller bronchial tubes,it occasionally gives rise to lobular pneumonia,or to collapse of some of the lobules of the lung.Lobar pneumonia may occur in the course of typhoid fever.When it comes on late in the disease,- especially if the patient be comatose,or even semi-unconscious,- it may be entirely overlooked,unless the lungs are carefully examined,as it often does not reveal itself by any of the ordinary symptoms.It may,however,occur early.It sometimes terminates in abscess or gangrene;but it is more usually followed by chronic pneumonia,which may eventually lay the foundation for pulmonary tuberculosis.

Pleurisy with effusion is also not an uncommon complication; and it is manifestly of serious import.Murchison refers to 3 cases in which it was followed by empyema.

Other morbid conditions which may complicate typhoid fever are: oedema,infarction,hypostatic congestion of the lungs,emphysema,and pneumothorax.Acute miliary tuberculosis is more often a sequel than a complicating condition.

CIRCULATORY SYSTEM.

Endocarditis and pericarditis are comparatively rare complications of typhoid fever.

Myocarditis is a frequent complication of severe attacks.Degeneration of the heart is probably present,in some degree,in every case of typhoid fever.The lesion of the heart muscle - as in the case of endocarditis and pericarditis - does not differ from that found in other acute infectious diseases.Myocarditis is always a serious complication,as there is always a danger of death by collapse or syncope.

Venous thrombosis is not a rare complication.It presents the same features,and runs the same course,as in other diseases.In rare instances,a portion of the thrombus may become detached and give rise to death by embolism.

Arterial thrombosis and embolism,giving rise to gangrene of the parts supplied by the obstructed artery,are of occasional occurrence.

Gangrene,unfortunately,is a rare complication of typhoid fever. Trousseau,Hayem,and others report,or refer to,several cases in which gangrene of the leg,hand,or cheek was observed;and,amongst others,a cases in which it depended upon obstruction of the carotid artery,and was located in the left ear,extending from thence to the forehead and cheek.Martin (Centralbl.f.Gyn.,1881) reports the case of a woman who expelled from the vagina a foetid-smelling structure of cylindrical form,which proved to be the cervix uteri,with the upper part of the vagina.Spillmann (Arch.gén.,March,1881) has also called attention to the occurrence of gangrene of the vulva and vagina in typhoid fever.Gangrene is seldom seen until near the defervescence of the disease.

Haemorrhage may occur during the attack.Its frequency from the nose and intestines has already received mention.It seldom occurs from the gastric vessels.

NERVOUS SYSTEM.

Acute meningitis is a somewhat rare complication of typhoid fever.Hoffmann reports only 4 cases of acute meningitis in 250 post-mortems.Both he,Murchison,and the older writers believe that when meningitis occurs it is secondary to pyaemia or disease of the middle ear,or to a tuberculous process.Keen,however,is of the opinion that a meningitis is not infrequent in this fever,and that it is often due to infection by the typhoid bacillus.He has collected a series of 15 cases,and in all Eberth's bacillus was found - in 12 in pure culture.Keen thinks that cases of cerebral meningitis are often overlooked by reason of the fact that the head is frequently not opened in typhoid autopsies,unless the cerebral symptoms have been very pronounced during life.

General convulsions are not common,but occasionally they do occur.Although a very grave symptom,they are not invariably fatal. Recovery took place in 4 of the 6 cases recorded by Murchison. They are not always associated with albuminuria.In only 1 of the 4 of Murchison's cases in which the urine was examined was it present.

Various forms of paralysis are occasionally observed after typhoid fever.According to Murchison,paralysis does not supervene until several weeks after the commencement of convalescence.It may last for several weeks or months;but recovery in the majority of instances eventually takes place.According to Nothnagel,the most common form of paralysis is paraplegia;but it may also take the form of hemiplegia,strabismus,paralysis of the portio dura,or motor paralysis of the individual spinal nerves - e.g.,the ulnar or peroneal.

Aphasia usually accompanies a right hemiplegia.Peripheral neuritis may sometimes be a complication or a sequel.Local neuritis is seen in the arms and legs by no means infrequently.Multiple neuritis may be seen in the same regions.

Muscular tremors have already been alluded to as common symptoms.Tender toes have been described by Osler and Handford as occasional sequels.Tetany sometimes appears during the convalescence - very rarely during the first week of the fever.

Chorea has been seen by Holt often in this disease,and more often than in any other infectious fever.Epilepsy is very seldom encountered at any stage of the illness.

The interesting condition known as "typhoid spine" has been described by Gibney.He regards it as a perispondylitis or acute inflammation of the spinal periosteum and attached ligaments.

Mental affections may follow typhoid fever - especially when the attack has been protracted and severe.Imbecility or stupidity may occur,and persist for months.Melancholia is perhaps the commonest form of mental derangement encountered.The patient may suffer from attacks of mania,which same may be of a very violent kind.Such persons are usually of an hereditary neurotic taint.Insanity may result from the nutritional disturbance consequent upon nervous exhaustion and insufficiency of food during the fever.All but maniacal cases usually recover,though slowly.

ORGANS OF SPECIAL SENSE.

EAR.- Acute otitis media somewhat frequently complicates typhoid fever,and especially in hospital practice.In Hengst's collection of 1,228 cases of typhoid,it was present in 28 - i.e.,in 2.28 per cent.It usually develops from the end of the second to the fourth week.Hengst believes that the mode of invasion of the middle ear is by extension of the catarrhal inflammation from the nasopharynx,through the Eustachian tube,though it is possible that occasionally the process is caused by cold draights of air on the side of the head,or by the entrance of cold water into the ear when the patient is being bathed.Purulent otitis media is probably always of microbic origin.Many varieties of bacteria have been found, either alone or in association.The pyogenic streptococcus and staphylococcus are the most common;but the diplococcus of pneumonia, the bacillus of Friedländer,and the bacillus typhosus are also sometimes present.Mastoiditis developed in but 1 of Hengst's 28 cases.All the cases ended in recovery - no chronic otorrhoea or deafness resulting.Keen has collected 31 cases of otitis complicating typhoid fever,making a total of 59 when added to those of Hengst.Although this complication is most frequent in severe and protracted cases,yet none of the 59 died.

EYE.- The ocular complications of typhoid fever are numerous. The following are the most important: Paralysis of the external ocular muscles;catarrhal conjunctivitis;suppurative keratitis;phlyctenular conjunctivitis and keratitis;iritis and choroiditis; cataract;retinal haemorrhages;and optic neuritis.

DIGESTIVE SYSTEM.

Pharyngitis - catarrhal or diphtheritic - occurs in a large number of cases,and frequently gives rise to great difficulty in swallowing.Indeed,it has been so frequently observed in some epidemics that certain authors regard it as a symptom rather than as a complication of the disease.

Keen refers to a case of acute glossitis.At most it appears to be an extremely rare complication.

The same remark applies to noma or gangrene of the mouth,which

is a very fatal disease.Murchison only saw it once,and Griesinger in only 1 out of 600 cases of typhoid fever.

Parotitis occasionally occurs in typhoid fever,but is much less common than in typhus.It is most frequently met with in bad cases about the end of the third week or later,and generally involves one side only.The swelling is hard and firm in the beginning,and may terminate in resolution or suppuration.Murchison saw it in only 6 cases, 5 of which were fatal.According to Hoffmann,16 cases of suppurative parotitis were found at Basle among 1,600 typhoid patients - 7 of the 16 ending fatally.Parotitis without suppuration occurred three times.In 15 cases the attack was confined to one side,9 times to the right and 6 to the left;in 4 it was double. Trousseau (Clin.Méd.de l'Hotel Dieu,T.i,1861) takes a very gloomy view of parotitis,and says that he has scarcely ever seen a case recover in which it had occurred,either in the course of typhoid fever or any other disease.On the other hand,it is regarded as critical and favourable by Chomel.In 2 of Keen's cases,the bacillus typhosus was found; in 1 case it was associated with the staphylococcus,but in the other Eberth's organism existed alone.

Ulceration of the oesophagus sometimes occurs.It usually causes no marked symptoms.In 2 cases Keen saw stricture follow.

Gastric ulcer occasionally occurs,but seldom gives rise to characteristic symptoms - its presence being discovered usually after death.Keen says haemorrhage from such ulceration seldom occurs without perforation.

Haematemesis is a rare complication of typhoid fever.Murchison and the older writers do not even mention it.Osler saw it three times only in a very large experience.

Perforation of the Intestine.

This is the most important and the most dangerous of all the complications of typhoid fever.Fortunately,it is not of frequent occurrence.Murchison observed it 48 times in 1,580 cases;Griesinger, in 14 of 118 cases;and Flint twice in 73 cases.Murchison found that in a total of 1,721 autopsies,the details of which were collected from various sources,it was the cause of death in 196,or 11.38 per cent.Schultz found that intestinal perforation took place in only 1.2 per cent of 3,686 cases treated in the Hamburg hospitals during the years 1886 and 1887.Hölscher found perforation in only 6 per cent.of 2,000 cases;and Fitz,in 4,680 fatal cases collected from various sources,found it present in 6.58 per cent.Keen's findings have approximated those of Fitz very closely.

Perforation takes place most frequently during the third week of the disease or thereafter.It may,however,occur as early as the first week,or as late as the sixteenth,as will be seen by the following tabular compilation by Fitz:

Date of the Occurence of Perforation.

Week.	Cases.	Per Cent.
First	4	
Second	32	16.5
Third	48	24.8
Fourth	42	21.7
Fifth	27	14.0
Sixth	21	13.4
Seventh	5	
Eighth	3	
Ninth	2	
Tenth	4	
Eleventh	3	
Twelfth	1	
Sixteenth	1	
	193	

Perforation is much more frequently met with in men than in women.The reason for this is unknown.Of 444 cases tabulated by Fitz,71 per cent.were in men and only 29 per cent.in women.The patients were men in 51 out of 73 of Murchison's cases;and in 72 of 106 cases collected by Nacke the sufferers were also of the male gender.It is extremely rare in children.Rilliet,Barthez,and Taupin met with it only three times in 232 children under treatment. Murchison has,however,had a fatal case in a child of five years of age.Fitz,in 192 collected cases,found it to have occurred only seven times in children under ten.The mildness of typhoid fever in childhood

probably accounts for its rarity at that period.

Perforation usually occurs in the lower portion of the ileum - in 82.4 per cent.of the cases,according to Fitz and Hawkins (197 of 239).In 25 cases,the opening was in the colon,in 8 in the vermiform appendix,in 7 cases the caecum,and in 2 cases the jejunum. Keen has found the colon most frequently perforated,and in its sigmoid portion;and when he finds no opening in the ileum,caecum,or appendix,he invariably submits the sigmoid flexure to a searching examination.Two or more openings existed in 29 of Fitz's 167 cases. Usually,however,the perforation is single.

Perforation occurs most frequently in severe cases of typhoid fever,and is preceded by symptoms of great gravity - e.g.,severe diarrhoea,great tympany,abdominal tenderness,and intestinal haemorrhage;but in a certain number of instances,the cases in which it has occurred have been of a mild character - the patient in many of them not considering himself ill enough to take to bed or even to abstain from his daily avocations.

Perforation is favoured by the irritation arising from any indigestible and unwholesome food,distension of the bowels by faeces or gas,vomiting,and movements on the part of the patient.Murchison refers to a case of Morin's in which the perforation was produced by the administration of an enema,and states that he could cite many instances in which the injudicious exhibition of purgatives had given rise to it.

The symptoms of perforation being due to the resulting peritonitis,are usually recognised without difficulty.Therefore, the accident may be suspected when the patient is suddenly seized with acute pain in the abdomen,accompanied by signs of collapse and occasionally by rigors.The fall of temperature is often considerable - it may be a few degrees,or more.Very soon the abdomen becomes tender on pressure,and,if it were not so before,hard and tympanitic;the pulse grows frequent,small,and sometimes almost imperceptible;the breathing is thoracic;the countenance expresses great suffering;the features are contracted;and the face is bathed in profuse perspiration.Nausea and vomiting come on soon after inflammation has commenced and rapidly exhausts the patient.The decubitus is dorsal;and the legs are generally drawn up so as to relax the abdominal muscles. Prostration rapidly increases,until death puts an end to the patient's sufferings.Occasionally the symptoms are more obscure.Pains and rigors may both be wanting,and nothing but extreme prostration,the frequent and feeble pulse,and the distended condition of the abdomen will indicate the gravity of such a dangerous case.This not infrequently obtains in delirious patients.Death may take place during the collapse,but this is rare.It more frequently takes place on the second or third day;on the other hand,it may be postponed until much later.Murchison refers to cases in which there was an interval of two or three weeks between the first symptom of perforation and the termination in death.

Perforation is almost invariably fatal,and that,too,sometimes within a few hours.Murchison lost 6 cases twelve hours after the symptoms began.Of 134 cases collected by Fitz,37.3 per cent.were fatal during the first week following the onset of the symptoms; during the second week 9 patients died;4 during the third week;1 lived thirty days;and another thirty-eight days.In rare instances recovery has been reported by physicians whose skill in diagnosis is universally recognised.Thus,Murchison reports 6 cases;Tweedie,2;and Ward,1. Bristowe (Trans.Path.Soc.,Vol.xi,p.115) and others say that recovery is possible.This view is sustained by the result of certain autopsies.In one of these,reported by Buhl (cited by Murchison), a perforation was found completely closed by adhesions to the mesentery;and in others reported by Murchison,partial adhesion had taken place between the edges of the perforation and the abdominal walls, or to an adjoining coil of intestine.Occasionally the inflammation excited by the perforation may be circumscribed,and terminate in abscess,which may permit a recovery by discharging itself into the bowel or externally.

Peritonitis is of all complications of typhoid fever the most serious.As stated,its most common cause is perforation;but it may be due to extension of inflammation to the peritoneal membrane without ulceration.It is believed sometimes to occur as a result of the typhoid infiltration so frequent in various tissues of the body taking

place in the serous membrane.In other cases it arises from rupture of softened mesenteric glands,of softened infarctions in the spleen, or of the abscesses which are sometimes the consequence of the circumscribed inflammation by which perforation is occasionally prevented from proving immediately fatal.Less frequent causes of it are rupture of the gall-bladder,with the escape of gall-stones into the abdominal cavity,abscess of the ovary,and abscesses in the walls of the urinary bladder.Murchison once saw it result from the bursting inwards of an abscess in the sheath of the rectus abdominis muscle.

Jaundice is a rare complication of typhoid fever.Griesinger saw it only ten times in 600 cases.Hoffmann found it in 10 of 250 fatal cases;and Murchison was able to collect 9 cases,all of which but one ended in death.Several of Griesinger's cases,however,recovered. Osler classifies the cases of jaundice in typhoid fever into four groups: (1) Catarrhal; (2) toxic; (3) those associated with abscess of the liver; and (4) those associated with gall-stones and cholangitis.Catarrhal jaundice is usually an early and transient symptom, and has no influence upon the course of the disease.

Affections of the gall-bladder and abscess of the liver are rare both as complications and sequels of typhoid fever.

The same also may be said for abscess of the spleen.Keen was able to collect only 9 cases.

GENITO-URINARY SYSTEM.

Acute nephritis is seldom seen in typhoid fever;it appears occasionally during the convalescence,and quite exceptionally during the continuance of the fever.The urine is heavily loaded with albumin,and usually contains some blood;tube-casts are found in the sediment,covered with epithelium,or fragments of the same;the secretion of urine is sometimes scanty,and a moderate degree of dropsy sets in,frequently beginning in the hands and face.The prognosis is usually good,the patients generally recover,and the nephritis subsides.

Pyuria has been seen ten times by Blumer.Osler says it is not uncommon in typhoid fever.The former regards it as a complication devoid of intrinsic gravity.

Haematuria is seen in severe cases,and is usually recovered from. Both it and haemoglobinuria are usually associated with renal disease.

Cystitis frequently attends the use of an unclean catheter,and resolves upon removal of this cause.

Urethritis may arise during convalescence,and apart from venereal infection.The prognosis is favourable.

During the convalescence male patients may suffer from orchitis or epididymitis without the previous existence of gonorrhoea.Keen has collected 32 cases,and points to mixed infection of Eberth's bacilli and pyogenic microbes as the cause.

The same observer mentions 4 cases of ovarian abscess,from the pus of which the bacillus typhosus was obtained in pure culture.

Gangrene of the genital organs is more common in women than in men.Both penis and scrotum are apt to undergo destruction (Keen, Fournier),and other parts according to sex.

Sometimes menstruation occurs prematurely during typhoid fever, and it may be profuse.It appears to be without effect upon the course of the disease.The function may be in abeyance for several weeks during the convalescence.

Pregnant women may suffer abortion or miscarriage.Of 14 pregnancies observed by Murchison,all but 2 aborted or miscarried,and 4 died.

OSSEOUS SYSTEM.

Arthritis occasionaly occurs in typhoid fever.Keen recognises three forms: (1) Rheumatic typhoid arthritis; (2) septic typhoid arthritis;and (3) typhoid arthritis proper.The first and second varieties are rare,and are usually polyarticular.The first may end in a multiple ankylosis.

Periostitis is an occasional sequel of typhoid fever.Sir James Paget (St.Barthol.Hosp.Rep.,Vol.xxi),who saw several cases of it, said that it never occurs in the continuity of the fever,but always when the patient is apparently convalescent,when his temperature is

normal and constant,and he is beginning to move about and to grow stronger and stouter.Its most msual seat is the tibia,but it is also met with in the femur,the ulna,and the parietal bones.Except in 1 case,he has never seen it in more than one bone in the same person. It is always circumscribed within a space of from one to three inches in extent,and usually subsides without necrosis or other lesion; but in such cases the patient has remained for some time subject to repeated attacks of pain and swelling of the periosteum.In a few cases,he says,in which periostitis is followed by necrosis,the extent of dead bone has always been less than that of the inflammation over it.Murchison,however,refers to 2 cases of necrosis of the tibia,and to 2 in which extensive necrosis of the lower jaw occurred. Gay (Trans.Path.Soc.,Vol.xx,p.290) also reports a case of extensive necrosis of the femur,in a child three years of age,following an attack of typhoid fever.Speaking of the date of onset of necrosis and bone disease in typhoid patients,Keen mentions that in 16 cases it occurred in the first two weeks;in 66 from the third to the sixth week;and in 104,months or years after the fever.Regarding the various forms of bone disease,Keen gives the following series for 1896:Necrosis in 35 cases; caries in 1 cases;periostitis in 107 cases; osteitis (bone abscess) in 12 cases; osteomyelitis in 10; granuloma in 2;and exostosis in 1 case - making a total of 168 cases. In the majority of cases the typhoid bacillus was found in pure culture; in the remainder there was a mixed infection with pyogenic micro-organisms.

SKIN,CONNECTIVE TISSUE,AND MUSCLES.

Furuncles and abscess in the skin,in the subcutaneous cellular tissue,in the muscles and the fascia beneath them,are frequently met with,most commonly at a late period or during convalescence. They are most readily developed at such points as are subjected to continuous pressure - e.g.,the back and buttocks,and may,under certain circumstances,prove to be the beginning of bed-sores. Muscluar abscesses are most frequent in the region of the glutei and calf muscles,less so in other regions.

Bed-sores at one time were among the most common and dreaded sequels of typhoid fever.Now,however,they are much less frequently encountered.They arise in consequence of the impaired nutrition of the tissues,the length of time the disease lasts,and the great emaciation which usually attends it.They constitute a very serious and troublesome complication,and may occur on any part of the body subjected to pressure;but they are most frequently seen over the sacrum and the trochanter.

Gangrene of the skin occasionally occurs at points that are free from pressure,where the circulation is defective.

Rupture of the muscles occasionally takes place,in consequence of the friability of the muscular tissue resulting from degeneration of the same.It is oftenest seen in connection with the abdominal muscles,and is often accompanied by haemorrhage.It may give rise to no symptoms,or end in suppuration and death from septicaemia.

Falling of the hair is one of the commonest sequels of typhoid fever,and may be considered the rule in severe cases.It usually takes place from the fourth to the eighth week of convalescence,and before it is complete the hair begins to grow again.

RELAPSES.

Those of the largest experience in the treatment of typhoid fever appear to be at variance regarding the frequency of relapses in that affection.Accoding to Gerhardt,they occur in 6.3 per cent.of the cases;Bäumler found them in 11 per cent.;and Biermer in 3.3 per cent. Murchison noted their occurrence in 80 of the 2,591 cases in the London Fever Hospital - i.e.,in 3 per cent.;and Maclagan in 13 of the 128 cases - i.e.,in 10 per cent.Immermann (Schweig.Corresp.Bl.,viii, 1878) says that they occur in 15 per cent.of the cases,and that in very unfavourable cases the proportion may be as high as 18 or 19 per cent.Henoch (Charité Ann.,ii,1875) observed relapses in 16 cases out of 96 - i.e.,in 16.6 per cent.Part of this difference of opinion is unquestionably attributable to the fact that under the term relapse are sometimes included two distinct conditions: (1) Mere recrudescences of pyrexia,which occur during the stage of defervescence or that of convalescence,and which are provoked by errors of diet,mental or bodily fatigue,or some other irritating cause.They usually last a day or two,and are entirely distinct from

(2) true relapses,in which all the characteristic symptoms of the primary attack are reproduced,which commonly occur some time after the disease has apparently run its course.There is occasionally no distinct apyretic interval between the two seizures;but,in by far the greater number of instances,the relapse occurs in the second or third week,or even later,after the establishment of convalescence. In 20 cases reported by Ord and Seymour Taylor (St.Thomas's Hosp. Rep.,Vol.ix,1879),the relapse occurred in the third week of the disease in 1;in the fourth week in 5;in the sixth week in 3;in the seventh week in 7;in the eighth week in 3;in the ninth week in 1. The duration of the relapse is usually shorter than that of the original attack.In Murchison's cases,the average length of the first attack was twenty-six days,that of the relapse fifteen days.In only 5 of the 51 cases was the relapse longer than the original attack of the disease.

The onset of a relapse is generally more abrupt than that of the original illness.It is rarely preceded by prodromata.The temperature rises more abruptly,and atains its maximum earlier;and it may be higher than it was in the original attack.Thus,it may reach 105° on the evening of the first day,and temperatures of 103.5° and 104° F. on the evening of the second day are not infrequently encountered.

The characteristic rose-coloured eruption appears earlier,as a rule;but,according to Jaccoud,it is usually not so abundant as in the first attack.Of 38 cases analysed by Murchison,the rash appeared on the third day in 7;on the sixth day in 2;on the seventh in 12; and at a later date in 2.The delirium also comes on sooner.The relapse is usually less severe,and of shorter duration,than the primary attack.The relapse usually terminates in recovery,but this is not always the case.Of Murchison's 53 cases, 7 were fatal.In 2 of the cases death was due to perforation;in 2 to peritonitis,induced by splenic infarction;and in 1 to abortion. Of Ebstein's 13 cases, 3 were also fatal.Occasionally a second - and,it is said,even a third - relapse is noted.Da Costa has twice seen four relapses.In one of his cases,during a second relapse,the patient succumbed to intestinal haemorrhage.

Many explanation have been forthcoming to account for these relapses.They arise from a re-infection with the typhoid poison;and it is generally believed that the second infection is from within the body,not from without.The clinical phenomena are accompanied by a renewal of the lesions of the intestine;and on post-mortem examination in fatal cases,the recent lesions of the relapse are usually found lower down in the bowel than the cicatrising ulcers of the original attack.Nothing satisfactory regarding the etiology of relapses has been discovered.Hamernjk and Maclagan allege that relapses are due to inoculation of the healthy Peyer's patches by the sloughs thrown off by those first affected,the same being favoured by constipation;but this theory is opposed to the experience of almost everyone who has paid any attention to the subject.It is more likely,however,as suggested by Liebermeister,that part of the typhoid poison remains latent somewhere in the body - not developed, destroyed,nor expelled during the first attack,but brought later into activity by some exciting cause.This view has received confirmation by Dupré and Chiari,who found the typhoid bacillus in the gall-bladder of patients suffering from typhoid fever.

ASSOCIATION WITH OTHER SPECIFIC DISEASES.

The fact of a person suffering from typhoid fever does not hinder him from taking another infectious disease - either during the actual attack,or in the convalescence therefrom.The following maladies may be noted in this connection: Typhus fever,measles,variola,varicella,malaria,diphtheria,scarlet fever,and pertussis.

VARIETIES OF TYPHOID FEVER.

Numerous,indeed,are the forms of typhoid fever described by various authors;but as many of them present few points of difference from the usual form of the disease,it will not be necessary to discuss them here at length.They derive their names from some peculiarity of the mode of seizure,from the prominence of some one symptom or set of symptoms,or from the presence of complications. They are,briefly,as hereunder set forth:

(1) THE ADYNAMIC FORM, in which prostration is marked in the beginning and throughout the attack.

(2) THE ATAXIC OR NERVOUS FORM, which is characterised by the predominance of delirium, subsultus tendinum, and other nervous symptoms.

(3) THE HAEMORRHAGIC FORM, in which there is a special tendency to haemorrhage from the various mucous membranes.

(4) THE ABDOMINAL FORM, in which the abdominal symptoms - such as diarrhoea and tympanitis - are well developed.

(5) THE THORACIC FORM, so called from the presence of some thoracic complication.

(6) THE GASTRIC OR BILIOUS FORM, in which the disease is complicated at its commencement by gastro-intestinal catarrh (la forme muqueuse of the French writers).

(7) THE ACUTE FORM, in which the disease begins abruptly and with great violence, and runs a rapid course, terminating usually in death before the end of the first week, or early in the second, before ulceration can have taken place. Delirium is an early and prominent symptom in this variety, so that it has sometimes been diagnosed as meningitis.

The following forms of typhoid fever, however, merit fuller consideration:

THE MILD FORM.

The general nature of the attack is indicated by its name. It is so light and rudimentary as often to escape recognition. But the spleen is enlarged, and a careful search will discover the rose-spots. The fever seldom lasts beyond two weeks and is of moderate height. Griesinger designated this form of the disease "typhus levissimus". The Widal test affords great assistance in the diagnosis of these somewhat doubtful cases.

THE ABORTIVE FORM.

In this variety of typhoid fever, the disease is - as its name implies - cut short in its course. There is every reason to believe that infiltration of Peyer's patches takes place as usual, but that the subsequent course of the disease is different - the glands undergoing resolution instead of advancing to ulceration. The majority of observers agree that in the beginning there is nothing to distinguish such attacks from those which follow their usual course. Jaccoud states, however, that their commencement is usually more abrupt than in the ordinary variety. Various observers assert that the temperature generally reaches its maximum earlier. They are occasionally characterised by severe symptoms, including a high temperature. The latter usually falls gradually, but sometimes the fever ends abruptly, and with profuse perspiration. Griesinger has seen defervescence occur as early as the fifth day.

THE AFEBRILE FORM.

This variety of typhoid fever is very rarely seen, and is distinguished by the insignificance of the fever or the entire absence of it. Liebermeister was perhaps the first to assert that typhoid fever could run its course without pyrexia. He often noticed this in Basle - the cases showing all the symptoms of the disease except hyperthermia. Many of the patients were confined to their beds for four weeks, or even longer. He regards these cases as the result of a minimum infection due to the widespread distribution of the typhoid poison in Basle. Cayley (Croonian Lectures, 1880) also refers to cases, and even to epidemics, of typhoid fever in which the temperature was below the normal throughout the whole course of the attack. Strube (cited by Cayley) had the opportunity of observing such an outbreak during the siege of Paris by the Germans in 1870. "In many of the cases", he says, "the temperature throughout was subnormal, and in others never exceeded the normal point. The roseola was usually profuse, the nerve symptoms were of marked severity, and were in inverse ratio to the temperature, consisting of violent delirium alternating with stupor; the duration of the fever was very short, defervescence usually taking place at the end of a fortnight. Of the 23 fatal cases, in 20 death took place during the first fourteen days. The abdominal symptoms were slight, but the characteristic lesions were found on post-mortem examination. All the cases were characterised by prostration. These cases presented some features which were

probably due to the peculiarity of the temperature; thus, the pulse was but little accelerated, seldom exceeding 100; the tongue did not become dry and brown; and the enlargement of the spleen was either absent or much less marked than usual." Strube attributed the peculiar features of this epidemic to the depressed condition of the troops: they had been exposed to great hardships on the way to Paris, overfatigued by forced marches, and insufficiently supplied with food.

THE LATENT OR AMBULATORY FORM.

This form - the typhus ambulatorius of the Germans, or "walking typhoid" - is of more importance, and from the fact that the symptoms are so mild, or that so many of the ordinary symptoms are wanting or masked by those due to complications, that there is great danger of regarding the attack as of little moment. In many cases there is no symptom present but prostration and fever to indicate that the patient is ill; and these may be so slight that he may positively refuse to take to bed, and may even insist upon pursuing his ordinary avocations, in the midst of which he is often suddenly seized with alarming symptoms - e.g., violent delirium, intestinal haemorrhage, or, what is more common, those due to perforation of the bowel. Still, even in these cases a careful examination will often disclose the presence of some symptom which had failed before to attract attention, and which will often reveal the true nature of the disease.

TYPHOID FEVER IN CHILDREN.

It was formerly thought that children were not subject to typhoid fever, which is now known to be common in childhood, though rare in infancy. The rose-spots are more often wanting than in adults, and the fever more apt to assume a distinctly remittent type; and, hence, no doubt, the difficulty which is often experienced in distinguishing typhoid from other fevers in children. There is no question but that many cases which have been described by authors under the head of "infantile remittent fever" are really examples of typhoid fever modified simply by the age of the patient. It may occur in infants not more than six months old, and is not infrequent in children of two or three years of age. Henoch (Charité Ann., 1875), who has had the opportunity of observing a large number of cases, says that the rise of temperature is commonly more abrupt in children than in adults, and that the disease generally runs its course in a shorter time. The pulse is more frequent, and may be as high as 144 in cases in which the prognosis is not grave. Dicrotism is very rare. Slowness and irregularity of the pulse - like that observed in basillar meningitis - he has never seen. The nervous symptoms are not so pronounced, even when the temperature is high. The stools may be brownish or greenish, instead of yellow; and diarrhoea is frequently absent during the whole course of the disease.

TYPHOID FEVER IN THE AGED.

Typhoid fever appears to be rare in persons over fifty years of age. It occasionally occurs, however, at very advanced ages. Of 5,911 cases at the London Fever Hospital, 27 patients were over 60 years of age, and 2 over 75. Trousseau observed a case in a patient 64 years of age; Wilks, 1 at 70; Lombard, 1 at 72; Heulard d'Arcy, 1 at 86; Hamernyck, 1 at 90; and Gueneau de Mussy, 1 at 100 years. In aged persons the febrile movement is generally prolonged, although of low grade, and the temperature rarely rises high - frequently during convalescence sinking below the normal. The diarrhoea is commonly not so severe, the delirium so violent, or the rose-spots so often present as in younger persons. On the other hand, adynamic symptoms - such as excessive prostration, tremors, subsultus tendinum, and the like - are frequently prominent from the beginning of the attack. Such patients frequently collapse from heart failure. The mortality is placed by Uhle at 50 per cent.

D I A G N O S I S.

GENERAL DIAGNOSIS.

During the first week the insidious invasion of typhoid fever, together with the absence of pathognomonic symptoms, always renders the diagnosis difficult, and sometimes impossible. Still, even at this time the existence of the disease may be suspected if the frequent use of the thermometer reveals from day to day a gradual increase of the fever and the existence of evening exacerbations followed by morning remissions, the temperature rising each evening from a degree to two degrees higher than it had done the previous evening. If, in addition to this character of the pyrexia there are diarrhoea with ochre-yellow stools or an increased susceptibility to the action of aperient medicaments, epistaxis, enlargement of the spleen, slight fulness of the abdomen, with tenderness and gurgling in the right iliac fossa, slight hebetude, and some confusion of ideas on awakening, - the diagnosis becomes probable. During the next week the symptoms are usually characteristic. The presence of marked abdominal symptoms, together with the appearance of the rose-spots, will generally render the recognition of the disease at this time an easy matter. There are, however, a few cases in which no rose-spots can be found, and in which the abdominal symptoms, if they exist at all, are so little marked that they escape notice. Even in these cases the temperature-chart, when carefully studied, will often throw a good deal of light upon the nature of the disease. If the febrile movement resembles that usual in typhoid fever, if it has continued for more than a week, if the patient has not been recently exposed to influences other than typhoid, and presents no symptoms of local disease, - the diagnosis may still be made with at least an approach to certainty in the vast majority of instances.

SERUM DIAGNOSIS.

The well-known agglutination reaction was first suggested, in 1896, by Widal for the diagnosis of typhoid fever. The history of the discovery and the researches of others leading up to it, though interesting, need not be dwelt upon here. It was at first thought that the mere occurrence of agglutination, produced by an addition of serum to a vigorous culture of typhoid bacilli, was sufficient to prove that the person from whom the serum was derived was, or had been, suffering from typhoid fever. It was, however, soon discovered that the serum of normal persons may produce this effect, if it be added in sufficient strength. A dilution of the serum to one part in ten was next adopted as the standard, but this again was found unsatisfactory. Then a 1 : 20 standard was substituted. For practical purposes this dilution is of considerable value; but it is now recognised that no absolute diagnosis can be made as to the existence of typhoid fever on a positive reaction occurring with a less dilution than 1 : 30, or even 1 : 50. With the stronger mixtures a time-limit of half an hour is necessary; with the weaker, the time of observation may be prolonged to two hours. Libman (Med. News, Jan. 30, 1904, p. 204) has succeeded in obtaining a positive reaction in as high a dilution as 1 : 50, when it is not present in more concentrated mixtures than 1 : 20. In testing he therefore always uses two dilutions each time.

For the performance of the test, either dried blood or serum obtained from a blister may be used. The serum can be more accurately diluted than the blood, and is therefore preferred for examination; but in practice the dried blood has been found to answer all the purposes of the test. The blood may be taken from the lobule of the ear or the tip of the finger - the usual antiseptic precautions being observed. The blood is collected in capillary tubes, or in a glass bulb drawn out at either end into a fine point - the ends being sealed in a flame afterwards. Coagulation takes place in the tube, and the serum which exudes from the clot is used for the test. There are several ways of securing the necessary dilution of the serum. For the greater dilutions, at least it is better to use a graduated pipette. Sterile broth is used for this purpose, but some prefer normal salt solution. The culture must be a recent and vigorous one, in which the bacilli are in active movement. In older cultures an agglutination substance is formed by the bacilli, and this diffuses out into the liquid: in such specimens the bacilli are found to have become clumped without the addition of any extraneous material, and are consequently unfit for use. When the dilution has been made, a drop of the mixed fluid is placed on a cover-glass, and

a hanging-drop preparation is made and observed under the microscope. The cover-glass should be ringed round with vaseline to prevent evaporation. A low power of the microscope will be sufficient to show, if true agglutination of the bacilli takes place, that almost all of them have run together into masses; while any that remain free have lost their motility and remain at rest. It is even possible to do the test macroscopically, by mixing the serum and culture in a test-tube or watch glass. If the reaction occurs, there will be a precipitate, and, according to Berliner and Cohn (Münch.med.Woch., Sept. 11, 1900), an asteroid arrangement in half an hour.

According to McWheeney (Bubl.Jour.Med.Sci., Sept., 1898), the test can be performed by growing the bacilli in hanging-drops - one with the serum to be tested, the other with the normal serum. (The serum is added in the proportion of 1 per cent., and the slides are kept at a temperature of 37° C.) If the reaction is positive, the bacilli in this drop will be seen to form chains, and to be non-motile, whereas in the negative experiment they are freely motile and separated.

A very precise and graduated quantitative test has been devised by Hewlett and Rowland (Brit.Med.Jour., April 28, 1900), who recommend that the serum be received into capillary tubes, of which the thickness of the walls and the diameter of the lumen may be measured microscopically, and the length of the column of serum ascertained. In this way the exact volume of serum is calculated. Subsequent dilution is effected by measured proportional amounts of broth.

Meyer (Berl.klin.Woch., 1904, p.166) and Ehrsam (Münch.med.Woch., 1904, p.662) speak very highly of the method of Ficker (Berl.klin. Woch., 1903, p.1,021), which aims at the performance of the test with dead bacilli, specially prepared and suspended in an indifferent fluid. The serum to be examined is diluted, 1 : 10, with saline solution and mixed with the slightly turbid test-fluid. If the reaction is positive, the mixture becomes clear - a slight precipitate falling to the bottom; ten to fifteen hours are required for the reaction to take place.

There can be no question as to the value of the serum test in the diagnosis of typhoid fever. Its securement is not, however, an infallible sign of the disease, nor yet an early one. Revieving the published reports of a large number of observers, it appears that the results of the test are in accord with the clinical diagnosis in about 95 per cent. of the cases. In the other 5 per cent., the reaction has not appeared. The absence of the reaction, therefore, in any individual case does not exclude the diagnosis of typhoid fever. Often it is not present until the diagnosis has already been made from the clinical manifestations under observation.

DETECTION OF TYPHOID BACILLI IN THE STOOLS AND URINE.

Mention has already been made of His's detection of the typhoid bacilli, in the stools of 90 per cent. of his cases, during the febrile stage of the disease; and that, too, often when the Widal reaction gave negative results. The specific bacilli are less frequently found in the urine, but they are sometimes seen there as early as the fourth day of the illness.

DIFFERENTIAL DIAGNOSIS.

The following are the diseases which are most likely to be mistaken for typhoid fever:

TYPHUS FEVER has a course which is so essentially different from that of typhoid fever that in well-marked instances it would scarcely be possible to confuse the one with the other. Cases do occur, however, which, in consequence of a very profuse and dark-coloured eruption in the latter, or of the existence of abdominal symptoms in the former, present at first a good deal of difficulty in diagnosis. The invasion of the former is more abrupt, and its duration shorter, than in typhoid fever. The eruption is usually also more copious; and it appears in the former as early as the fourth, fifth, ot sixth day, - while that of the latter is rarely observed before the seventh day. The fever of the former is much more nearly continued in type than that of the latter. Defervescence occurs in the former by crisis: in the latter by lysis. The expression of the face is different in the two diseases. In typhus there is a uniform dusky hue of the face, with injection of the conjunctivae and contraction of the pupils. In typhoid fever the pupils are often

widely dilated, the conjunctivae clear, and the face pale with the exception of a circumscribed flush on each cheek. Diarrhoea is much less frequent in the former than in the latter; and when it does occur, it is not accompanied by "pea-soup stools." Epistaxis, tympanitis, pain and gurgling in the right iliac fossa, and intestinal haemorrhage - common symptoms in the latter - are very infrequently met with in the former. On the other hand, petechial spots and vibices - which are of almost constant occurrence in the former - are rare in the latter. The circumstances, also, under which the two diseases are contracted are different; and the character of the prevailing epidemic is helpful in their differentiation.

SIMPLE CONTINUED FEVER may readily be mistaken in the beginning for typhoid fever - especially in those cases attended by diarrhoea; but, as a general rule, the different character of the febrile movement, its more abrupt commencement, and its shorter duration, together with the absence of the rose-spots, will usually serve to distinguish it.

INFLUENZA occasionally resembles typhoid fever. The following symptoms are common to both affections: fever, attended by weakness, sleeplessness, delirium, sweating, and sometimes diarrhoea; pulmonary catarrh, deafness, epistaxis, and a dry and red tongue are likewise seen in both. The differential diagnosis rests chiefly upon the occurrence of influenza in widespread epidemics, the short duration of the attack, the atypical temperature-curve, and the absence of the eruption and of the abdominal symptoms that are usually associated with the diarrhoea of typhoid fever.

ACUTE GENERAL MILIARY TUBERCULOSIS may readily be mistaken for typhoid fever, owing to the similarity of the symptoms. The chief points of difference are these: In typhoid fever, the temperature-range is typical, or more or less confined to a definite type, - whereas that of acute miliary tuberculosis is extremely irregular. In typhoid fever, diarrhoea and some degree of tympany are common; in acute miliary tuberculosis diarrhoea is rare, and the abdomen is apt to be flat and often scaphoid. In typhoid fever, epistaxis and enlargement of the spleen occur; in tuberculous meningitis, these symptoms are rare or absent altogether. The headache of typhoid fever is dull, while that of tuberculous meningitis is acute and usually associated with intolerance of light and sound. In typhoid fever, vomiting is much less common than in tuberculous meningitis. Convulsions - especially in the early part of the disease - are likewise rare; and the headache of typhoid fever disappears upon the occurrence of delirium (Jenner), - whereas in tuberculous meningitis headache and delirium may alternate from the beginning. In tuberculous meningitis, moreover, tubercles will be seen in the choroid by the aid of the ophthalmoscope.

TUBERCULOUS PERITONITIS may be mistaken for typhoid fever when it is of gradual onset; but leucocytosis is present in this as in the other forms of tuberculosis, and the temperature is irregular and may be subnormal.

MALARIAL FEVER and typhoid fever are not infrequently mistaken for each other. The diagnosis of malarial fever is especially founded on the proof of splenic tumour, parasites in the blood, and melanaemia. Parasites and pigment, however, are not always to be found in the peripheral blood. In such cases the blood for examination must be extracted from the spleen by means of a Pravaz syringe, and with due observance of the usual antiseptic precautions. The presence of a single parasite in the blood confirms the diagnosis of malaria; and the presence of the Widal reaction and the absence of the parasites in question does the same for typhoid fever.

CEREBRO-SPINAL MENINGITIS may be simulated by the cerebral for of typhoid fever. The rarity of the former disease should, however, be borne in mind, as well as the fact that in it there is usually leucocytosis, - whereas, in typhoid fever the blood gives the Widal reaction.

APPENDICITIS can be distinguished by the local symptoms as contrasted with the constitutional ones of typhoid fever. Furthermore, the onset in the former disease is more abrupt, the pain and tenderness in the right iliac region are more acute than in the latter; and, in place of gurgling in this region, there is a sense of resistance of a swelling on pressure, as well as dulness on percussion.

P R O G N O S I S.

PROGNOSIS ACCORDING TO SYMPTOMS.

In typhoid fever the prognosis should always be guarded, as accidents of a fatal character frequently occur in cases which are apparently progressing satisfactorily; and, on the other hand, recovery has often taken place after all hope of it has been abandoned. But, although it is impossible to predict with absolute certainty the result in any particular cases, there are certain symptoms which furnish important indications for prognosis - the proper appreciation of which will generally enable us to arrive at a correct conclusion as regards the gravity of the disease. Prominent amongst these is the character of the pyrexia. An attack of the disease characterised by high temperature should always give occasion for great anxiety. This is very fully shown by the statistics of the hospital at Basle. Thus, of those patients in whom the temperature did not reach 104°, only 9.6 per cent. died; in those who attained or exceeded 104°, 29.1 per cent. died; and, finally, of those in whose axilla the temperature rose to or above 105.8° F., more than half died. Fielder (Deut. Arch. f. klin. Med., Bd. 1, p. 534) also found, in the cases observed by him, that in those patients whose temperatures had risen to or exceeded 106° F., more than half succumbed. According to Wunderlich (Eigenwärme, p. 300), at 106.16° the danger is considerable; at 107.06 the deaths are almost twice as numerous as the recoveries; and at 107.24 and over, recovery is rare. Murchison has, however, known recovery to follow a temperature of 108° F.

The prognosis is more unfavourable in typhoid fever when the temperature is continuously high, and when the morning remissions are slight or wanting, than when the daily fluctuations are greater - even though the temperature may reach a higher point during the evening exacerbations in the latter variety than is attained in the former. Occasional remissions - even if produced by drugs or other remedial measures - are to be regarded favourably, as they indicate that the fever tends to subside. A high morning temperature ought, therefore, to give rise to more alarm than a high evening one. The prognosis is grave when the morning temperature rises to 104°, or is persistently above 103° F. Murchison says that recovery is rare after a morning temperature of 105° F. Fielder saw, with one single exception, all patients die whose temperature in the morning rose to or exceeded 106.25°; while of those whose temperature in the morning rose to 105.44°, - even if only on one day, - more than half died. Any marked deviation from the usual temperature-range in the course of the disease is unfavourable. A rapid rise of temperature indicates increased danger: it may be due to the occurrence of a complication, or of some other cause acting unfavourably upon the patient. A sudden and decided fall should excite even more alarm, as it is generally the consequence of a free intestinal haemorrhage. A temporary abatement of the fever, with amelioration of the other symptoms, occurring between the tenth and twentieth days, and giving rise to the hope that convalescence is about to commence, but followed by a return of the symptoms in an aggravated form, is also unfavourable. Murchison, Chomel, Louis, and Bartlett regard such cases as almost hopeless.

The outlook is very unfavourable in cases in which coma or wild or violent delirium comes on early. A moderate amount of delirium, - especially when it occurs at night, or in the morning upon awakening, and is readily dissipated by attracting the patient's attention, or stupor which disappears when he is thoroughly roused, is not unfavourable. Insomnia, subsultus tendinum, carphology, slipping down in the bed, incontinence of urine or faeces, and retention of urine, are all symptoms of bad omen, as is also rigidity of the limbs. Excessive subsultus is especially unfavourable, as it is generally most marked in cases in which intestinal ulceration is extensive. The same may be said for meningitic symptoms, apoplectic accidents, epileptiform or general convulsions. Less dangerous, again, are melancholic conditions, or other marked forms of mental disease, which appear in the course of the disease or during convalescence. Extreme deafness is without significance in prognosis, as it appears in mild as well as in severe cases.

The frequency of the pulse plays a prominent part in the prognosis,as a change in its character,and also in that of the heart-beats,may be often the earliest indication of the approach of danger in typhoid fever.The first change is usually a diminution of the intensity of the first sound of the heart.This is significant,as it is frequently the earliest premonition of cardiac failure,to which a large proportion of the deaths in this disease are due. A pulse of 120 and over - especially if it is at the same time feeble - is also unfavourable.Intermittence of the pulse is another bad sign - especially if,according to Hayem,it occurs during the first week of the disease.In convalescence intermittence is not an unfavourable symptom.The prognosis is bad also in those cases in which,with excessive weakness of the pulse,there are other evidences of cardiac failure - as,for instance,congestion of the lungs, cyanosis of the surface,and coldness of the limbs.A very frequent pulse is not so unfavourable in a child as in an adult,or in a person of nervous temperament.Other unfavourable symptoms are a dry and brown tongue,excessive tympanitis with abdominal tenderness,severe diarrhoea,vomiting when it occurs late in the disease,intestinal haemorrhage,and colliquative sweats.The delusion sometimes observed in very severe cases,in which the patient declares that he is not ill,is a very bad sign;and among sudh cases Louis asserted that he had never known recovery to take place after having been once manifested.Peritonitis is a very serious complication - whether due to perforation or some other cause.Still,it has sometimes been recovered from:therefore,it is not invariably fatal.

On the other hand,favourable symptoms are a gradual decrease of the temperature with increased morning remissions,moistening and cleansing of the tongue,a lessening of the delirium,and other nervous symptoms,reappearance of an intelligent expression,recognition by the patient of his friends and attendants,and a diminution of the diarrhoea.Cases in which constipation exists generally do well.A copious eruption is also regarded by many as a favourable symptom.

It is beyond question that the individual peculiarities of a patient exercise an extraordinary influence upon the course and character of the disease,and that to a great extent upon these peculiarities the prognosis in particular depends.

MORTALITY.

In dealing with the question of the mortality of typhoid fever, it is necessary to note that the influence of AGE is important. Murchison found that in a large number of cases the death-rate at various ages was as follows: Under 10 years of age the death-rate was 11.36 per cent.; from 10 to 14 years,12.86 per cent.;from 15 to 19,15.48 per cent.;from 20 to 29,20.46 per cent.;from 30 to 39, 25.90 per cent.;from 40 to 49,25 per cent.;and above the age of 50 years the death-rate was 34.94 per cent. IIn the case of children, leaving out the first year of life,the prognosis is decidedly more favourable than in adults.The deatherate among children in the first year is high - especially among the new-born.Taking all the cases together,the mortality in childhood is decidedly lower than in adults - probably not exceeding 1 per cent.The published statistics relating to infantile mortality are without value,except as showing these general facts.Typhoid fever,like all the acute infectious diseases,shows an extremely variable intensity in children - the severe cases,however,being the exception than the rule.Among the cases of typhoid among individuals over forty years of age collected by Uhle,more than half proved fatal.Age,therefore,exercises a positive influence upon the outcome and mortality of the disease.Its influence is less decided in typhoid than in typhus fever,in which the death-rate does not reach 4 per cent.until after the age of 20, when it rapidly rises from 12.34 per cent.until it reaches 57.03 per cent.in patients above fifty years of age.The comparatively slight mortality of typhoid fever among children is probably due to the fact that the temperature is less often continuously high in them than in adults,and that while hyperpyrexia is frequently present,it is generally better borne,and less likely to produce paralysis of the heart.It is also said that the intestinal lesions are not so severe,and the liability to complications and sequelae less marked, in childhood.

In the female SEX the mortality from typhoid fever appears to be somewhat greater than in the male. Thus, the mortality, according to Murchison, at the London Fever Hospital was about 1 per cent. higher among the female than among the male patients. Murchison reagrds the excess of mortality among the former as not arising from the influence of child-bearing upon the course of the fever, since it is less decided at that epoch of female life than between the ages of five and fifteen.

The SOCIAL CONDITION of the patient is without influence; for not only are the rich as liable to contract typhoid fever as the poor, but the disease is quite as fatal among them. Murchison found, from the statistics of the London Fever Hospital, that the mortality is not greater among the destitute than among the better class of patients; and he expresses the opinion that in private practice typhoid fever is probably more fatal among the upper classes than among the very poor. Many other observers are of the same opinion.

All observers agree that the PHYSICAL CONDITION of the patient - i.e., the circumstance whether the sufferer from the disease be lean or fat - is of great influence upon the course of typhoid fever. It is a well-established fact that when very corpulent individuals are attacked with typhoid, the prognosis is very unfavourable; and the popular belief that stout persons are more endangered by the disease than weakly ones, is based upon truth. If we enquire concerning the causes which explain the unfavourable course of the disease in corpulent individuals, we find that a variety of circumstances must be taken into consideration. In the first place, experience shows that in these cases the temperature generally reaches a higher degree. Moreover, fat persons possess a slighter resistance to elevation of temperature; the parenchymatous degenerations of organs appear earlier and are more developed, and the heart especially is liable to hold out less readily for any length of time. Finally, we must also bear in mind that treatment is much less effective in corpulent persons, owing to the fact of their metabolic powers being less active than in the lean. Murchison says that a large muscular development is likewise an unfavourable element in the prognosis, and that he has seen the strong and robust succumb to the disease oftener than the feeble.

The mortality from typhoid fever appears to be greater in CERTAIN FAMILIES than in others. This has been ascribed by some writers to peculiarities of constitution; but it may be due to other causes - as, for instance, differences in the intensity of the poison.

Typhoid fever is also often very fatal among those addicted to the vice of INTEMPERANCE. Such persons usually bear the disease very badly, in consequence of the presence of various degenerations of one or more of the important organs of the body caused by the excessive indulgence in alcoholic stimulants. Death, in the case of drunkards, occurs very often from paralysis of the heart.

RECENT RESIDENCE in an infected locality has been shown by Murchison and others to have a decided influence in increasing the fatality of the disease.

Persons attacked by typhoid fever for the SECOND TIME generally suffer from it to a much milder degree than in the first instance.

The influence of PREGNANCY is variously estimated by authors. Murchison says that it is a far less formidable complication than is usually thought; whereas others, of no less repute, hold a directly opposite opinion.

Persons who suffer from CHRONIC DISEASES, if attacked, as is rarely the case, by typhoid fever are in greater danger than healthy individuals. Patients with heart affections, emphysema, or bronchial catarrh are said to be more liable than others to cardiac paralysis. Diabetics are likewise in great danger.

The GENERAL MORTALITY of typhoid fever is very variable, and exhibits this character in different years, as well as in different seasons of the year. Certain epidemics have been exceedingly fatal, while in others the percentage of deaths has been small. There can be no doubt that in most of these cases there has been a difference in the virulence of the poison. Statistics as to the mortality of the disease to be reliable must, therefore, be based upon a large number of cases extended over several years.

Murchison placed the mortality-rate of typhoid fever at about 15 per cent. Other observers have obtained slighly different results. Thus, the mortality was 11.16 per cent. in the 197 cases analysed by Hale, and 13.5 per cent. in the 303 cases collected by Jackson. Cayley (Med. Times & Gaz. 1888) found the death-rate of the several hospitals

in London to be 17.8 per cent.;and Geissler (Schmidt's Jahr.) that it was in all the German hospitals 12.8 per cent.in 1877,and 13.5 per cent.in 1878.Flint had 18 deaths in 73 cases,or 24.4 per cent. Previous to the introduction of the Brand method of treatment,the death-rate in hospitals ranged from 12 to 25 per cent.,with an average mortality of 17 per cent.A remarkable exception to this high rate is afforded by the Cork Street Fever Hospital,Dublin, in which,during the twenty years ending March 31st,1891, 1,405 cases of typhoid fever were treated,of which only 121 proved fatal, or 8.6 per cent.The mortality in private practice is,for obvious reasons,considerably less than in hospitals.The stage of the disease at which efficient treatment is begun has a marked influence upon the result.This is strikingly shown by some observations of Jackson: 90 cases were admitted to the Massachusetts General Hospital during the first week - of these 7 died,or 1 in 12.85; 139 cases were admitted in the second week - of these 16 died,or 1 in 8.68; 46 cases were admitted in the third week - of these 10 died,or 1 in 4.60;and 21 cases were admitted in the fourth week,and of these 5 died,or 1 in 4.20.Convalescence also occurred much earlier in those who were admitted at an early stage of the disease.Making due allowance for the varying severity of typhoid fever in certain epidemics,the death-rate of the disease can be estimated at 10 per cent. all round.

T R E A T M E N T.

PROPHYLAXIS.

SANITARY MEASURES.

These,if properly carried out,may be expected to prevent to a great extent,if not entirely,the origin and propagation of typhoid fever.All are now agreed as to the great importance of an efficient system of sewerage,with a thorough flusing of the sewers,at regular and frequent intervals,for disposing of the faecal discharges of all towns,no matter how inconsiderable in size.No less important is it that the drains of every dwelling should be well constructed and kept in good order.They should be trapped just before they empty into the sewer,and should be provided with a means of thorough ventilation between the trap and the walls of the house by a free communication with the outer air.The soil-pipe should be carried up three or four feet above the top of the house; and every water-closet,bath,and washstand,and also sink should have its own separate trap;and none of them should be placed in rooms unprovided with a window,or with some other sufficient means of ventilation.Medical practitioners should,as sanitarians,urge upon the authorities of all cities and towns the importance of deriving their water-supply from a source unpolluted by sewage,or by any other substance likely to be deleterious to health.They should also see that when water is stored in a tank inside of a house,the overflow pipe does not communicate directly with a drain,- since,if this is allowed to occur,the water may very soon become contaminated with sewer-gas and consequently unfit for internal use.In the case of isolated country houses and of small villages,some other means of disposing of the faecal discharges of the inhabitants other than by sewers has to be found.Often a cesspool has to be utilised.Care should,however,be taken that this is so constructed and situated that there can be no filtration of its contents into wells from which drinking-water is derived.

As the infection is commonly conveyed in the stools and urine, the importance of thoroughly disinfecting them cannot well be over-estimated.Disinfection of the faecal discharges is to be accomplished by the action of powerful chemical agents.Chloride of lime,dissolved in pure water in the proportion of six ounces to the gallon,may be used for this purpose.One quart of the solution is to be poured over each discharge,thoroughly mixed with it,and the vessel allowed to

stand for an hour or more before being emptied into the privy or water-closet.If the discharge be very copious,it is advisable to use even a larger amount.For the disinfection of solid faecal matter the above solution should be used of double strength.The matter to be disinfected should be exposed to the action of the solution for four hours,and solid masses are to be broken up by the agitation of the vessel.A solution of carbolic acid (1 : 20),or of sulphate of copper (1 : 25),may be used for this purpose;but the best of all is corrosive sublimate in the strength of 1 : 500.The fluid should be coloured red by the addition of potassium permanganate,and kept in a glass bottle,- for the reason that corrosive sublimate is decomposed by contact with copper,lead,or tin,mercury being precipitated.Formaldehyde - a product of wood alcohol - is strongly recommended for the disinfection of typhoid stools.An 8-per-cent.solution of the gas is employed.Though rapid in action,it is somewhat expensive.No stools from a case of typhoid fever should be thrown into a closet without having been previously disinfected as above. Great care should be taken to prevent the contact of the discharges with the wood-work of the seat.The closet is to be fully flushed several times a day,and a quantity of a carbolic-acid-solution,or chloride-of-lime-solution should be allowed to remain in the pan during the intervals of its use.The stools,even after thorough disinfection,should never be thrown upon the ground.In camps or country districts,where there ar no water-closets or privies,the stools should be mixed with sawdust and burned,or buried in trenches four feet deep and covered with milk of lime.The trenches should always be distant from any source of water-supply,and also far removed from the kitchen or larder.It is very important to bear in mind that the stools,whether in bedpan or trench,should never be left exposed to the air,but should always be promptly covered with a disinfecting solution.After each movement of the bowels,the buttocks and anus of the patient should be cleansed with a 1 : 60 carbolic acid solution,or a 1 : 2,000 one of corrosive sublimate,followed by hot water and soap ablution.The mattress should be protected with a rubber cloth placed under the sheet.All body linen and bed clothing used by the patient should be soaked for several hours in a 1 : 20 carbolic acid solution,or one of corrosive sublimate in the strength of 1 : 1,000,and then boiled for at least thirty minutes.Thermometers,ehema syringes,and all utensils coming in contact with the patient, should be cleansed with soap and water,and similarly disinfected. Nurses should wash their hands thoroughly with hot water and soap, and disinfect them - especially before eating or manipulating the patient or his appointments - with corrosive sublimate solution of the above-mentioned strength.Furthermore,disinfection of the stools should be continued until the patient is convalescent and able to leave his bed.The same attention should,of course,be accorded the urine.Finally,after death or recovery of the patient,the mattress, bedclothes,and all other articles that have come in contact with him,should be thoroughly dried or disinfected or burned.

GENERAL MANAGEMENT.

The successful treatment of typhoid fever is largely dependent upon the attention which is given to the general management and nursing of the patient. As soon as the disease has declared itself,or is suspected,the patient should be put to bed without delay,and not allowed to leave it on any pretext,not even to empty his bladder, after the first week.This is a golden rule which should be rigidly enforced in every case - no matter how mild the symptoms of the disease may be.Its non-observance - either through the neglect of the practitioner or wilfulness of the patient - has been the cause of many disastrous results: in illustration of which it is only necessary to refer to the frequency with which perforation of the bowel occurs in the so-called "walking cases" of the disease. Perfect quiet should be maintained in the sick-room.Visitors should be excluded from it,and the attendants limited in number to those actually necessary to carry out the directions of the physician. The nurse,or nurses,should be possessed of the highest intelligence. At the beginning of the illness the attending physician should give to the nurse specific instructions as to the general management of

the case,the diet,and the disinfection of the discharges and bed-linen;and he should also see that his instructions are understood and carried out.At his daily visit he should write out his directions for the twenty-four hours,and receive from the nurse a written report of the amount of nourishment,number of discharges,and other clinical data of importance.Constant watching should be maintained from the beginning of the disease to the end of convalescence.In the sick-room all unnecessary talking is to be avoided - and especially conversation in a loud voice,which is always distressing to the patient.As repose of mind is only second in importance to that of the body,the patient must not be informed of any exciting news or disturbing communication - postal or otherwise.

In view of the long duration of typhoid fever - the patient being rarely able to leave his bed under four weeks,and more frequently being obliged to keep it for a much longer time - the sick-room should,whenever practicable,be large,airy,sunny,and provided with an open fireplace:the latter is a much more efficient means of securing thorough ventilation than an open window,or furnace heat,or steam.The room should not be too warm,and the temperature should be steadily maintained at between 65° and 68° F.If two rooms are used, the window of the unoccupied one should be kept constantly open day and night.Screens serve to guard the patient from draughts,and are conducive to sleep by softening the light.The bed should be single, so that the patient may be easily got at from either side,and the covering as light as possible.The mattress should neither be too hard nor too soft.A feather mattress must never be used.One of springs,and covered with a hair mattress,makes the best bed for a prolonged illness.A rubber cloth should be spread under the sheet. The latter should be kept smooth to prevent the formation of bed-sores,and the patient's position frequently changed.This likewise lessens the danger of hypostatic congestion of the lungs.The back, the sacral and trochanteric regions should be bathed at least once a day with alcohol.Should a sore appear,it must be protected by an air cushion,and treated on antiseptic principles.Protracted cases require a water-bed.Among the minor duties of the nurse - which are not,however,of minor importance - are the moistening of the patient's mouth,cleansing his tongue,the prevention of the accumulation of sordes,and the most scrupulous care of his person in other obvious respects.

DIET.

The careful regulation of the diet is also a point of great importance in the management of typhoid fever.The difficulty lies in feeding a patient who is likely to be ill for some weeks,who has a diseased condition of his bowels,and whose convalescence is apt to be slow and in need of careful attention.Owing to the presence of the pyrexia,there is an actual diminution in the digestive and absorptive powers;the digestive juices are less active,and the amount of hydrochloric acid in the stomach is less than usual.The liver is more or less disturbed,and the bile is less actively secreted than in health.Peristalsis is lessened,and absorption defective.In addition,ulcerations occur in the intestines,and are liable to go on to perforation.Food and drink should be given at regular intervals,both by day and by night;the appetite of the patient should not be consulted,for these patients are apt to be often apathetic and have no desire for food.The nourishment should be given at intervals of from two to four hours,according to the condition of the patient and the quantity taken at a time.The question of drink is also of great importance in these cases,for thirst is often a distressing symptom.Pure water - given with or without ice - is to be depended upon;but,if there are no contraindications, this may be varied in many ways.The natural spring waters,or,if they cannot be obtained,the artificial ones,are most useful.The artificial waters contain large quantities of carbon dioxide;and,to avoid trouble,they should be allowed to effervesce before they are given to the patient.If there is no marked intestinal disturbance,fruit-juice may be added to the water.Lemonade,raspberry-juice,or raspberry-vinegar and water are often welcome changes.Weak tea also tends to allay the thirst.Cold and weak coffee is preferred by some.Red wine and water,white wines,or even sherry and brandy and water,may be given to some patients - especially if plain water causes unpleasant symptoms.When there are irritability of the intestines and severe diarrhoea,red wine and weak tea are to be preferred.Albumin-water, since it combines both food and drink,is most useful.It may be

flavoured with lemon- or orange-juice,or may be shaken up with a little sherry or brandy.The various mucilaginous drinks may be used,but are not generally relished. Gum-arabic-water,arrowroot-water,bread-water,barley-water,oatmeal-water,and similar beverages are allowable.But the food par excellence in this disease is milk. There is no food that meets so many indications as it.It possesses great nutritive value,is easily procured,as a rule,and is generally easily administered.It must be borne in mind,however,that there are some patients with whom milk disagrees,and many who do not like it.The amount to be given varies between one and three quarts,according to the patient.If milk is given plain,it is usually only a question of time when it will disagree with the patient.Children are more apt to take it over long periods of time than adults.There are many ways of modifying milk and rendering it more agreeable and more digestible to the patient.The simplest method is to add from one to three ounces of lime-water to each glass of milk,or plain water or a mineral water may be used instead.If milk is well borne and it is desired to increase the amount of nutriment,cream may be added to it.If this causes unpleasant symptoms,it should be discontinued at once.Butter-milk may be given occasionally,but is far inferior in nutritive value to plain milk.Kumiss or kefir may be used;and when they may not be relished at first,most patients learn ultimately to enjoy them.A pinch of salt may render milk more palatable to some persons,while the addition of a teaspoonful of brandy may be relished by others.The milk may be given cold,be flavoured with fruit-juices,vanilla,or nutmeg,or it may be given in the form of ice-cream.When milk is not well borne,it is a good plan to prepare barley-water,and add to it an equal quantity of milk,boiling them together for a few minutes.Plain boiled milk may also be used with benefit.Among the disagreeable symptoms to which milk gives rise may be mentioned a bad taste in the mouth,a sense of fulness or pressure in the abdomen,eructation,or even pyrosis.When the milk is not well digested,it may cause diarrhoea,with colicky pains,and the undigested curds will be found in the stools.Malted milk may be mixed with some of the invalid foods,or it may be partially or completely peptonised.

When milk disagrees with,or becomes distasteful to,the patient, meat broths are useful.They may be prepared from beef,mutton,veal, or chicken.They may contain a little rice or barley,but should be strained before they are taken.The juice expressed from slightly broiled beefsteak is of great value in typhoid fever,and is usually well borne.If diarrhoea exists,beef and mutton broths are apt to aggravate it,and must not be given too frequently.Bouillon may be employed,as may also the various liquid beef preparations and meat-juices now on the market.Mosquera Meat Jelly and Valentine's Beef-Juice are useful but expensive.Beef-extracts are more stimulating than nutritious.Some prefer to use gelatinous substances - such as gelatin,calves'-foot jelly,bottle-bouillon,and the like.Clam-soup and oyster-stew,or oysters with gelatin,give agreeable variety to the diet.

It is not advisable to give eggs too freely.Egg-water,however, when properly prepared,rarely causes distress.Raw eggs may occasionally be given,or the yolk of egg in bouillon or broth.Eggs and milk together may cause indigestion;but if the patient is in need of a stimulant as well as a food,brandy and egg in mixture may be used,-and in moderate quantities this is nearly always well borne.

Plasmon,nutrose,somatose,eucasin,and similar preparations may be exhibited in accordance with the directions of their manufacturers.

Alcohol should not be given in typhoid fever as a matter of routine.The tendency today is to give it in smaller quantities than formerly,and many have abandoned its use altogether.It is a valuable ally,nevertheless,in overcoming the disease,and should not be discarded.It should not be given to children as a routine treatment; but even in young patients it is often of great service.It is, moreover,not necessary to prescribe it always,even in severe cases, at the beginning of an attack.In habitués,alcohol will be needed from the outset.The chief indications for its use are to be found in the state of the heart,the pulse,the tongue,and the nervous system.If the impulse of the heart grows weak and the first sound obscure,or the pulse becomes soft and compressible or unduly rapid or weak or irregular,alcohol is called for.A dry and brown tongue indicates,as a rule,the need of stimulants;and under their use it will often become moist and clean at the edges.The presence of

extreme restlessness,or of low muttering delirium,is usually an indication for the exhibition of alcohol;and the same may be said for the presence of complications in general,and the"typhoid state" in particular.It is not possible to lay down any general rule as to the amount to be given,even in severe attacks.This will vary in different cases,and to a certain extent will be determined by the effects manifested by its exhibition.

HYDROTHERAPY.

The cold-water treatment of typhoid fever is that most generally accepted at the present day.It is by no means a novelty;for it was, in the form of cold-water affusion ,practised in the treatment of fevers as long ago as 1887 by Dr.James Currie,of Liverpool,who may be said to have introduced it;and who asserted that it had the power of not merely of moderating the symptoms of these diseases, but also,in many cases,of cutting them short.It enjoyed at first a high degree of popularity,which lasted from twenty to thirty years, but finally fell into disuse - probably in consequence of the exaggerated character of the claims which were made for it by its advocates.Although resorted to from time to time in various parts of the world,the merit of having brought it again into notice is due to Ernst Brand,of Stettin;and his vigorous and persistent advocacy of its merits has led to its being called by his name. Since the publication of his work on "The Hydrotherapy of Typhoid Fever," in 1861,the recorded observations of Bartels,Jürgensen,Liebermeister, and others in Germany,and of Wilson Fox and others in England have so far restored the treatment to professional favour that there are few physicians in this country or abroad who do not both advocate it as opportunity indicates or affords.

Hydrotherapy may be applied in various ways,of which the most important are as follows:they all act in the same manner,and depend for their efficacy upon their power of abstracting heat from the body,and are useful just in proportion as they exert such antipyretic action.There is no doubt that under their use distressing and dangerous symptoms (e.g.,coma,stupour,subsultus tendinum,and the like) are often much relieved,the heart and pulse strengthened,the respirations made deeper and slower,and the general mortality markedly reduced.

(1) The Cold Bath.- Of all methods of applying the cold-water treatment,this is the most effective.The bath for an adult should be at the temperature of 68°F.,and its duration should be about ten minutes;if,however,the patient shows signs of great weakness,it should not exceed seven.After the bath he should be wrapped up in a dry sheet or light blanket,and put to bed forthwith.If the pulse should then show signs of failing,or if there should be shivering or other signs of weakness,he should be given a dose of wine or brandy or some other stimulant,and bottles containing hot water should be applied to his feet.The process of cooling goes on for some time after the patient's removal from the bath;for,while the thermometer placed in the axilla will show that the external temperature is immediately affected by it,the same instrument placed in the rectum will indicate a gradual fall,which will continue in many instances for half an hour.Shortly after this,the temperature will be observed to rise;and in many cases it will not be more than two hours before it has attained its former height.It is therefore necessary to use the thermometer frequently,and to repeat the baths as often as the temperature rises to 103°F.or above it.Usually not more than six or eight a day are required in the worst cases.It often requires some persuasion to overcome the repugnance which most patients feel at first for these baths;and the shock of being suddenly immersed in cold water is agreeable to very few.Later,however,this repugnance entirely disappears - at least in the vast majority of instances. Intestinal haemorrhage,perforation of the bowel,and great weakness of the heart's action are all contraindications to the use of the cold bath.The existence of pneumonia,or of hypostatic congestion of the lungs,is not - in the opinion of many - a sufficient reason for abandoning it,but rather an indication for its employment.

The Gradually-Cooled Bath.- As the use of this form of bath involves less shock to the system,it is preferrred in some cases to the cold bath.It is,therefore,more suitable than the latter for nervous and excitable persons of advanced age or of general feebleness of constitution,or for very young children.In it the temperature

of the water,which at the time of immersion of the patient should be at or above 95°F.,is cooled by the gradual addition of cold water until it is reduced to 72° F.,or below this point.These baths, to produce the same effect as the cold baths,must be of longer duration.They are contraindicated in the same conditions as the latter,but to a less degree.

(3) Cold Affusion.- This consists in placing the patient in a tub,and throwing cold water,- 60° F.,- by means of a sponge,over his head,face,neck,shoulders,and chest.This is repeated once or twice just before he is removed from the bath.It is done rather for the sake of its good effects upon the nervous system,in cases of great stupour and other conditions of serious nervous derangement, than merely as a means of reducing the high temperature,- for which latter purpose it is very inferior to the cold bath. Cold affusions may be practised in bed,the patient being suitably protected by a mackintosh sheet.

(4) The Cold Pack.- This is given as follows: A blanket is spread evenly over the bed or couch;over this blanket is laid a coarse sheet wrung out of water of the prescribed temperature and folded once.The patient is lifted upon the bed thus prepared,and quickly wrapped in the wet sheet,by the attendant,in such a way that it lies as smoothly as possible over every part of the body except the head.If the extremities feel cold before the packing,they must be warmed by friction or else not included in the packing.So soon as the wet sheet is everywhere in contact with the body,the attendant folds the blanket over the patient in the same manner,first drawing over and tucking one side smoothly under,and then the other - seeing that the chin is free,and that the blanket is folded evenly, but without tension at the neck.Finally,the long end is drawn down, and folded smoothly under the feet.Three or four thicknesses of wet sheets are spread over the blanket - these being necessary to reduce the temperature effectively.The reduction of temperature from a single pack is usually transient;and repeated packings - even to the number of five or six - are often administered,the rise of temperature being slower after each.When the temperature does not rise above normal,or when shivering takes place,the packing must not again be renewed.When repeated packings are necessary,two couches may be used side by side,and the patient lifted directly from one pack to the other.By unfolding the blanket and sprinkling the sheet afresh with cold water,the same effect is produced,but less completely.The patient should be allowed to remain in the last pack for half an hour to an hour.At the expiration of this time the skin generally becomes pleasantly warm,and perspiration occurs in many cases.

(5) Cold Sponging.- In the hands of a skilful nurse,cold sponging not only adds to the comfort of the patient,but also exerts a favourable influence upon the nervous system,and upon the circulation of the blood,by causing it to flow more freely in the vessels directly under the skin.The spongings lower the temperature only slightly,- unless the water be very cold and the procedure frequently repeated,- and are,therefore,by many clinicians assigned a very low place among the methods for abstracting heat from the body.The water used may be of the temperature of the body,or slightly cooled with ice.The addition of a little alcohol or vinegar will serve to increase the effect of the sponging.A sponge or wash-cloth may be used,and more moderate friction according to the sensations of the patient.In all use of water,great care must be taken to protect the bed.Every part of the body is in turn bared,washed,dried,and again covered.The spongings may be repeated at intervals of two or three hours according to the indications present.

(6) Cold Compresses.- For this purpose,three or four thicknesses of old table linen or towelling - porous enough to hold a sufficient quantity of water - will be found most useful.The compress is wrung out of water of the required temperature,and reapplied as it becomes warm;or two compresses may be used alternately,each being cooled in turn by placing it on a block of ice in a basin or pan at the bedside.Cold compresses are often used on the head,and are commonly very acceptable to patients.They are without appreciable effect upon the general temperature,and only produce a local fall of body-heat. Leiter's coils exert an effect analogous to that of cold compresses,and are applied fitted to the head or other regions of the body - the water being circulated through them from an overhanging resevoir.

(7) The Application of Ice.- Ice is usually applied by means of a bladder or a specially constructed bag.It must be cracked into pieces the size of a walnut,and introduced into the bag with a little water - the bag being about a half or two-thirds full.The air is then squeezed out,and the stopper adjusted.If the bag be filled,or air enough be left in to distend it,it will conform itself to the part to which it is applied.A much more effectual method of applying ice to the abdomen or over the heart is by spreading out a thick layer of finely-cracked ice between the folds of a coarse towel,which is then placed directly over the skin.It is not avaliable for prolonged use;it is almost sure to wet the bedding,and t the method requires constant watching.Frictions with ice are powerful means of depressing the temperature of the body,and may therefore be resorted to when,for some reason or other,the cold bath cannot be obtained,and when not contraindicated by the condition of the patient.

(8) Ice-Water Enemata.- The temperature may sometimes be reduced by rectal injections of iced water.No more than three or four ounces should be employed at a time.They are,when carefully administered, rather grateful than otherwise to the patient.

MEDICINAL TREATMENT.

Mild cases of typhoid fever do not usually require much therapeutic interference.The chief indications for treatment,- apart from complications,which are treated on their own merits in terms of the febrile affection existing,- are furnished by the height of the temperature;and this is best met by measures of hydrotherapy as just detailed.

Antipyretics.

Internal antipyretics are still in great favour with many practitioners,but less so since the value of the Brand treatment has come to be almost universally appreciated.Of the antipyretics in use,quinine and the coal-tar derivatives are the most important.

In order to produce a decided antipyretic effect, quinine must be given in large doses.Murchison says that a dose of from 15 to 20 grains causes,within an hour or two,a fall of temperature and,to a less extent of the pulse-rate,which may last from twelve to eighteen hours;and that he has never known any other disagreeable symptoms result from its use than noises in the ears,temporary acceleration and irregularity of the respiration,and occasional vomiting.This quantity will,however,often be found to be insufficient to produce a notable reduction of the temperature,and it is therefore necessary occasionally to increase it.Liebermeister was accustomed to give adults from 22 to 45 grains of the sulphate or hydrochlorate of quinine;and this dose had to be taken within the space of half an hour,or,at most,an hour,- as it is useless,he says,to expect the full benefit of this dose to appear if it is divided and its administration extended over a longer time.He never repeated it in less than twenty-four hours,and,as a rule,never gave it again before the lapse of two days.Jürgensen has exceeded the dose of 45 grains without observing any bad effects from it.When these large doses are taken,the fall of the temperature usually begins a few hours after the administration of the remedy - the minimum being reached in from six to twelve hours;and it is usually not until the second day that the temperature attains its former height.It is found in practice that the most decided results are obtained when the drug is given in the evening;so that the time of its fullest antipyretic effect will coincide with that of the morning remission.When these large doses produce vomiting,as they occasionally will,the remedy may be given by the rectum or hypodermically.Quinine,it should be noted,possesses the great advantage over the cold bath that it may be given in conditions in which it would be dangerous to resort to the latter.The existence of great cardiac weakness,of perforation of the bowel,or of intestinal haemorrhage do not usually constitute contraindications to its use.

Acetanilid,antipyrin,and phenacetin are the most important of the coal-tar derivatives.Although,if given in sufficient doses,they will,as a rule,reduce the temperature,their use is not unattended with danger.Numerous instances have occurred in which dangerous, and even fatal depression and callapse have followed their administration - even in moderate doses.The employment of these drugs as antipyretics should be limited to acute fevers of the sthenic type:

they are not suitable for continued administration in an adynamic fever like typhoid.The occasional use of a small quantity as an adjuvant to the cold bath is admissible,but even in such cases it is as well to give a stimulant at the same time to counteract any possible depressing action.The use of guaiacol - extolled by many - is open to the same objections as the coal-tar preparations. When painted on the skin,it produces a prompt - though temporary - fall of temperature.

SPECIFIC OR ETIOLOGICAL TREATMENT.

This aims at the destruction of the typhoid bacilli and their products in the intestinal canal.It is done by means of ANTISEPTICS, which also arrest fermentation and check the activity of the ordinary intestinal bacteria,which are believed to become virulent in consequence of association with the bacillus typhosus.A large number of antiseptic drugs have been employed for the purpose,and apparently with great benefit.The duration of the disease is not usually shortened,but its course is rendered mild and its mortality lessened.The assumption that typhoid fever can be artificially aborted has been made upon insufficient evidence.Undoubted cases of spontaneous abortion of the disease are occasionally observed. The alleged termination of typhoid fever in the course of a few days, as a result of some special form of treatment,demands the incontrovertible evidence of a large series of cases to establish its correctness.The cold-water treatment is by far superior to the antiseptic treatment about to be described.The latter is intended rather for use in those cases in which the former is of incovenient or negatived application.

Calomel has,perhaps,been more systematically used than any other drug.It is employed not only because of its antiseptic properties,but because it is also a safe and efficient laxative.It is very popular in Germany,where 7½ grains of the drug,and in some cases a much larger dose,are given four times daily,on alternate days,as soon as the nature of the disease is fully recognised. It is claimed for this treatment that,when it is begun early,the rate of mortality and the duration of the disease are much less than the same otherwise would be.Its advocates,however,admit that the latter is not always the case.Salivation is rarely produced by the calomel.The administration of each dose is followed by a decided, although temporary,reduction of temperature;and the diarrhoea,which is at first increased by it,subsequently diminishes.

Rosenbach recommends naphthalin,which may be given alone or with calomel.As an antiseptic it is much inferior to others;and its vaunted abortive effect in early cases has never been satisfactorily established.

Beta-naphthol is a powerful,non-toxic,and - in proper doses - non-irritant germicide.From 5 to 10 grains may be given three times a day in wafers,capsules,or tablets.If constipation exists,salicylate of magnesium may be combined with it,or salicylate of bismuth if the opposite condition requires an astringent (Bouchard).The drug is very highly spoken of.Abdominal pain and meteorism diminish,the tongue becomes clean and moist,and the passages lose their offensive smell.Convalescence is more rapid,and secondary complications fewer.

Thymol is also a very efficient antiseptic,and may be given in doses of from 20 to 40 grains per diem.

A mixture of tincture of iodine and carbolic acid,in the proportion of two parts of the former to one of the latter, has been highly recommended in this disease - especially when nausea and vomiting are present.It does not,however,exert any local action upon the intestinal canal,as it is readily absorbed from the stomach.

Chlorine-water was recommended long ago by Sir Thomas Watson and Murchison.It has since been popularised by Burney Yeo.The necessary solution of chlorine gas is prepared as follows:Thirty grains of powdered potassium chlorate are placed in a bottle,of the capacity of twelve ounces,and forty minims of strong hydrochloric acid poured upon it.To prevent the escape of the chlorine gas,the bottle is tightly corked until quite filled with the greenish-yellow gas.Little by little,the bottle is then filled with water - the bottle being well shaken at each addition.Burney Yeo adds to twelve ounces of this solution twenty-four or thirty-six grains of quinine and an ounce of orange-peel syrup;and he gives to an adult

an ounce dose every two, three, or four hours - according to the severity of the case. Yeo claims from his combination of chlorine and quinine great possibilities and remarkable effects. The tongue cleans quickly, and the offensiveness of the evacuations subsides within twenty-four hours after beginning the treatment. There are also a modification and a sustained depression of the pyrexia, the average course of the disease is shortened, the physical strength and intellectual clearness of the patient are maintained with less need for stimulants, there is a greater power for assimilating food, and a rapid and complete convalescence, as well as, Yeo says, great antisepsis.

The value of salol as an intestinal antiseptic is established. It has, however, the same disadvantage as naphthol in being insoluble in water. By the action of the pancreatic juice it is decomposed into carbolic acid and salicylic acid. It acts upon the alimentary canal like naphthol; and it may be given in wafers, capsules, or tablets. Hare says it is likewise a urinary antiseptic, as in its elimination it sterilises the urine. This is denied by Mark Richardson, who found typhoid bacilli persisting in the urine, after a daily dose of thirty grains, for thirty days.

Richardson recommends urotropin as vastly superior to salol as a urinary antiseptic. He has convinced himself of its reliability in this respect by actual experiment.

ANTITYPHOID SERUM.

Bokenham (Trans. Path. Soc., 1898, p.373), in 1898, prepared an antityphoid serum, by inoculating a horse with filtered cultures of the bacilli and then with dead bodies of the organisms themselves. This serum confers immunity upon rabbits. Krumbeim (Cited by Walker, - Jour. of Path. & Bact., 1901, p.25L) uses filtered cultures, then bacteria killed by carbolic acid. The bacilli are grown for fourteen days in broth, to which one-half per cent. of phenol is then added. The cultures are injected subcutaneously, and considerable constitutional disturbance may be produced, and abscesses also. The serum of the horse is drawn off, and used after a dosage of 150 c.c. has been reached. Antibacterial serum has, so far, however, given unfavourable results in the hands of those who have tried it.

ANTITYPHOID EXTRACT OF JEZ.

By means of this extract, Jez claims that in typhoid fever the general condition of the patient improves, the pulse becomes slower, the temperature falls considerably, and the morning remissions become more marked, diarrhoea being also checked. Jez treated 18 cases with this extract, and all recovered. Other observers have had similarly fortunate results. The extract is prepared by injecting rabbits with a typhoid culture and so immunising them, killing the animals, and then extracting the minced-up spleen, brain, and spinal cord, as well as the bone-marrow, and the thymus gland, with a solution consisting of sodium chloride, glycerine and alcohol, with a little carbolic acid. It forms a dark and reddish-brown fluid of alkaline reaction, which is given by the mouth, in dessertspoonful doses, ebery one or two hours, according to the severity of the symptoms, until the temperature becomes remittent, then every three hours until the morning temperature is brought down to 100.5·F. An ordinary case requires about seventeen ounces of the extract.

PETRUSHKY'S TYPHOÏN.

Petrushky (Deut. med. Woch., 1902, p.212) reports good results with a preparation, which he designates typhoïn, consisting of dead bacilli, in cases of ordinary typhoid fever. It is contraindicated when the disease is advanced, and also when there is a tendency to cardiac failure or general intoxication, or complications exist. It has not been received with favour by the profession.

WRIGHT'S VACCINE.

This aims at prophylaxis, but may be conveniently considered at this juncture. The method is really founded upon the experiments of Pfeiffer and Kolle (Deut. med. Woch., 1896), made in 1896, as to the effect of inoculating patients with cultures of typhoid bacilli. Wright's vaccine consists of cultures of the bacillus typhosus grown in broth for four weeks, and then sterilised by heating, for from ten to fifteen minutes, at 60·C. The vaccine is sterilised and preserved by the addition of carbolic acid or lysol. For injection into a man the minimal dose is the minimal lethal one for a guinea-pig weighing 100 grammes. Redness and pain at the site of

inoculation are produced, as well as some (usually) slight constitutional disturbance. This, however, may be severe and serious; and Wright now uses a weaker vaccine given in two divided doses (Practitioner, March, 1904, p.361). Statistics - mainly from observations on the different units of the British Army in South Africa - speak eloquently for the efficacy of the remedy, which is very rapidly coming into general favour.

SYMPTOMATIC TREATMENT.

HEADACHE.- The headcahe of the early days of the attack generally requires no special treatment; it subsides spontaneously between the end of the first and the middle of the second week. Absolute quiet, exclusion of light, local applications, e sometimes cold, sometimes warm, - constitute, as a rule, all that ought to be done to relieve it. A mustard plaster to the nape of the neck is often of service. If still persisting, from three to five grains of antipyrin, or of phenacetin, at short intervals, will usually suffice to dissipate it. For severe cases, suppositories of the extract of opium (gr.½) may be employed.

INSOMNIA.- In the early days of the disease insomnia is often an important symptom. Like the headache, it usually diminishes some time during the course of the second week; on the other hand, it is occasionally persistent and exhausting. Bromide of sodium (gr.xv) and chloral hydrate (gr.viii), in combination, are probably the most efficient hypnotics for use in typhoid fever; but they should be very carefully handled if the heart is weak.

DELIRIUM, SOMNOLENCE, and STUPOR are best relieved by hydrotherapy and stimulants. Among the latter, alcohol stands first and almost alone; spirits of chloroform and of camphor are of use in emergencies; either may be administered subcutaneously, or a 5-per-cent. solution of camphor in ether. Ammonium carbonate is of inferior value; it is, however, frequently used in the treatment of pulmonary complications. Siberian musk is a powerful stimulant in conditions of nervous depression. Its high cost, and the difficulty of obtaining it, stand in the way of its general use in these cases. If delirium be marked or coma threaten, great benefit is often derived from the local applications of cold to the head, by means either of the cold douche or of the ice-cap - the hair being previously cut short. These applications must be transient and not too frequently repeated, otherwise they may produce depression or collapse. At the same time, warm applications to the feet and legs, and sinapisms to the precordia or epigastrium, are called for. The tepid or warm bath is often followed by good results. Tyson says he has obtained almost magical results by the application of leeches to the temples or behind the ears when the symptoms suggest incipient meningitis; blisters are, however, to be avoided. Dover's powder usually dissipates nocturnal restlessness, as also do valerian, camphor, and the bromides. The condition in question yields to catheterism when retention of urine produces it, which is frequently the case. Active delirium yields, as a rule, to hypodermic injections of hyoscine in 1/200 gr. doses. Good nursing and perfect quiet are essential in these cases.

EPISTAXIS is rarely so severe as not to yield to the use of simple remedies - such as the application of ice to the forehead or back of the neck, or of styptics locally. In a few cases, however, it is profuse; and it will then be necessary to have recourse to hypodermic injections of ergotine, plugging of the nostrils, linseed poultices to the back of the neck, or adrenalin chloride.

VOMITING is not a common symptom except early in the disease, when it can usually be checked by the administration of an emetic and by the applications of sinapisms to the epigastrium. The use of emetics is no longer advisable when it occurs after the first week. It is then better to trust to small doses of hydrocyanic or carbolic acid, aromatic spirit of ammonia, calomel, or bismuth. It will be often found that lime-water and milk will remain upon the stomach when every other article of food or medicine is rejected. In some severe cases this symptom may be relieved by the frequent administration of small quantities of brandy in iced soda-water. Small quantities of ice, or teaspoonful doses of very hot water, often effect the same purpose.

TYMPANITIS.- This common symptom of typhoid fever occasionally calls for prompt relief; for, in addition to interference with the descent of the diaphragm and other discomforts which it produces,

the distended condition of the bowels increases the risk of perforation.It is usually sufficient to employ embrocations or stupes of equal parts of turpentine and olive oil,or of camphor liniment.If the tympanitis coexist with constipation,enemata - either with or without a small quantity of turpentine - may often be used with advantage.If it is extreme,an intestinal tube should be introduced very carefully into the rectum,and the gas drawn off. Charcoal,asafoetida,beta-naphthol,and salol have been given in this condition with a view of preventing or arresting decomposition of the intestinal contents.When the tympanitis is due to sebility and to a paretic distension of the bowel,it is to be met by free stimulation with whisky,and also by the use of strychnine in full doses.Puncture of the colon is an operation attended with considerable danger to the patient,and by many good authorities is not believed justifiable in this disease.

DIARRHOEA.- So long as the stools are of moderate amount,and do not exceed three or four in the twenty-four hours,this condition does not call for special treatment:if,however,the evacuations are copious or frequent,it becomes necessary to control them.When diarrhoea is due to errors in diet,- such as the use of improper food or excessive amounts of food,particularly milk and the strong animal broths,- it usually abates upon the substitution of a more suitable dietary.Diarrhoea may also arise in consequence of the patient's drinking excessive amounts of fluids,which pass through the bowels without being absorbed and stimulate the secretions of the intestinal mucous membrane.In the absence of these causes,it is to be attributed to lesions in the intestines.It is then best treated by disinfectant and soothing remedies - e.g.,bismuth subcarbonate or subnitrate in large doses every four or six hours. To this may be added,if necessary,opium in doses proportionate to the age of the patient;but care should be taken not to produce constipation. Opium may be advantageously administered in enemata of starch-water or suppositories,with or without the tincture of cannabis indica.Any of the other astringents or intestinal antiseptics may,in the event of the above-mentioned remedies proving useless, be administered.

CONSTIPATION.- This may require attention more frequently than diarrhoea.When it is present so early in the course of the disease that its diagnosis is still uncertain and has continued for several days,it is best to prescribe a small dose of olive or castor-oil;for the inordinate action which frequently follows the administration of this mild purgative will often dispel all uncertainty as to the nature of the disease one has to deal with.When it occurs in a more advanced stage of the disease,it is best met by the administration of enemata,which may contain,if there is much tympanitis present,a small quantity of turpentine.As pointed out by Baglivi (Fuge purgantia tanquam postem.OPera Omnia Medico-Practica et Anatomica,1788),strong cathartics are utterly inadmissible.

INTESTINAL HAEMORRHAGE.- When bleeding from the bowel occurs, the intestinal tract must be given complete rest for several hours. An ice-bag,cold applications,or a cold-water coil should be placed upon the abdomen.To relieve the thirst,the patient may be allowed to suck small pieces of ice,or ice-cold water,or cold tea may be given in spoonful doses.After some hours the patient may be given a teaspoonful of cold milk;and this may be repeated every two or three hours.Beyond this,if the bleeding is severe,the intestinal tract should be given complete rest for twenty-four hours or longer.Opium, acetate of lead and opium,sulphate of iron,nitroglycerine,ether, strychnine,ergot,and other styptics may also be used.If the haemorrhage has been profuse,normal salt solution should be given by the rectum,after raising the foot of the bed.It is necessary to exercise great caution in the return to regular fever-diet.

PERFORATION.- P e r i t o n i t i s,whether due to perforation of the intestine or to other causes,calls for the free administration of opium.When perforation occurs,all food must be discontinued,and surgical treatment instituted;or,where this is not possible,large doses of opium or morphia may be prescribed.Following operation,- which,according to Keen,must not be done during the immediate primary shock which lasts during the first few hours,- the diet must be that of the intestinal perforation which has been dealth with by the surgeon.If the patient rallies without surgical interference, or where this has been found impracticable,food may be given after

an interval of twenty-four hours, but only in very small quantities at sufficiently wide intervals. It is best to begin with teaspoonful doses every three hours; and, if the food is retained, this may be gradually increased. When food is rejected, which is usually the case, aggravation of the condition must be prevented by giving the stomach complete rest.

CARDIAC WEAKNESS requires the free exhibition of alcohol, the of strychnine. The latter may be given hypodermically in doses of gr. 1/13 to 1/12 every four hours in urgent cases. Some clinicians, however, prefer caffeine, or combine it with strychnine. Digitalis is not always a safe remedy - especially when myocarditis exists. Nitroglycerine (gr. 1/50 in alcohol or ether) hypodermically usually meets the indications presented in cases of sudden cardiac failure. sinapisms to the precordia and epigastrium are useful adjuvants to these measures. The foot of the bed must be raised, and the pillows removed when the weakness of the circulation is extreme.

OTHER COMPLICATIONS AND SEQUELAE require attention on general principles.

MANAGEMENT OF CONVALESCENCE.

During the first few weeks of convalescence, the diet requires as much care and attention as it received during the febrile period of the attack; in fact, since these patients often develop a ravenous appetite, born of several weeks' milk diet and fever, even greater care is necessary. The patient's wishes should in no wise govern his diet; and relatives and friends should be seriously cautioned against giving him anything not specifically ordered by the medical attendant. The ulcers in the intestine often remain unhealed for some time after the subsidence of the fever; and errors in diet may therefore readily cause recrudescences of fever, if not true relapses and death. As during the early days of convalescence the temperature remains labile, morning and evening thermometric observations should be taken for at least a week; and during this time the diet must be restricted to milk, eggs, custards, animal broths or jellies, and the lighter farinaceous foods. At the end of a week, wholesome and easily digested solid food - including meat - may be resumed; but the effect of such changes of diet upon the temperature and general condition of the patient is to be carefully watched. If diarrhoea persists, it is to be treated by bismuth and small doses of opium - either alone or in conjunction with the mineral acids. If there is a tendency to constipation, simple enemata or glycerine suppositories may be employed for its relief. Milk, with whisky or wine, once a day, may be of service during convalescence. In severe cases, in which much alcohol has been given during the illness, it is usually necessary to continue stimulation for some time after the subsidence of the fever. Otherwise, alcohol should be dispensed with as soon as possible. Quinine, iron, and cod-liver oil may be given if the convalescence be tardy and anaemia persists. Care should be taken not to let the patient sit up before the end of the first week. It is important likewise to guard patients at this stage from undue fatigue or excitement of any kind. Finally, a change of air and scene should, whenever possible, be secured.

P A R A T Y P H O I D F E V E R.

This is a form of typhoid fever that has lately assumed some prominence in the literature, though numerous authors do not even mention it, or dismiss it in a few words. Others, again, devote considerable space to its discussion,- especially the Germans,- and endeavour to draw sharp distinctions between it and the parent disease.

In spite, however, of the assertions to the contrary, paratyphoid fever - a term invented by Ch. Achard and B. Bensaude, in 1896 - cannot be distinguished from ordinary typhoid fever by any clinical phenomena. Its presence may, nevertheless, be suspected by the absence or impairment of the Widal reaction, that is to say, in the presence of the usual symptoms of typhoid. The real distinction, however, is a bacteriological one; for the casual agent of the affection is the paratyphoid bacillus - an organism which Kayser affirms to be of the size of the colon bacillus, a sort of hybrid between it and the bacillus typhosus. It is actively motile, and of about the same size and shape as the latter microbe. The rods stain prominently at the poles with carbol-fuchsin when examined in the blood; and the colonies on gelatin have a sort of waxy appearance, are iridescent, transparent, pale gray in colour; but, unlike the colon organism, there is no vein-like indentation on the surface. Furthermore, in gelatin-stab culture, the growth is not so broad as the colon one, and there are no marginal projections. No indol is produced, no matter how long one waits for it; and in neutral red agar, one will observe the development of a greenish fluorescence in thirty-six hours. Bouillon is clouded as in the case of the colon organism, but not so uniformly; and milk is not affected by its presence. The reaction with lithmus is the same as in the case of the bacillus typhosus. Fermentation with sugar is marked; and the bacillus is pathogenic to mice and guinea-pigs. The same author recognises two kinds of paratyphoid bacilli, which he names A. and B.- the same differing from one another as regards cultural properties and in their sensitiveness to agglutination. In lactose, muscle-sugar-free bouillon, type A. forms an air-bubble, but type B. produces fermentation a fourth less than in the case of the colon bacillus. Again, the latter is thicker and forms whiter gelatin colonies than the former; and from the second week type B. destroys the sourness of alkaline whey and completely clears milk. Various authors affirm that they have been utterly unable to isolate these paratyphoid organisms; from which it is evident that its identity is far from being established, though doubtless future research will place the bacteriology of the affection - which, as stated, many refuse to recognise - on a sure bacteriological footing. The disease has been attributed to the ingestion of diseased meat; and numerous epidemics of it have from time to time been reported. The TREATMENT of the affection in no wise differs from that of the parent affection, nor are the indications of the individual case in any wise to be specially departed from.

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CLINICAL OBSERVATIONS.

Case 1.

Mrs. M.,aged 40,was delivered of a healthy female child on September 19th - eight days before expected. On the 21st,an ounce of castor-oil was administered;but this had no effect. This dose was repeated on the morning of the 22nd,and during that day the bowels moved freely. At night the patient had a severe rigor,and the temperature in the axilla was 103°F. In the morning it fell to 99°F. It again went up to 101°F. at night,and the following morning it fell to 100°F. This elevation of temperature was accompanied by severe diarrhoea and headache. The patient also complained of a sensation of chilliness,loss of appetite,and thirst. The tongue was coated with a brownish-yellow fur,and had a red tip and edges. The pulse was quick and easily compressible.The stools had a very offensive odour.

In view of the suspicion of there being some uterine mischief, she was well douched out with an antiseptic solution;and an examination was made per vaginam,which,however,failed to demonstrate the presence of anything abnormal.

At this stage treatment was mainly directed to reducing the temperature and allaying the diarrhoea.For this purpose a mixture of chalk and opium was given,and the patient was put on boiled milk with lime-water.

After three or four days,the symptoms became very characteristic of typhoid fever.The temperature presisted in rising,being a degree or two higher each evening than the evening before.There was delirium at night,and tympanitis and tenderness over the entire abdomen,and especially so on pressure being made in the region of the right iliac fossa.

The stools were of a distinct pea-soup character;and the spleen was found to be enlarged.The well-known symptoms of typhoid fever were in due course observed.

The milk given the patient was substituted by whey,as a good deal of the curds of milk was found in the motions. This had the effect of reducing the number of evacuations.

On the sixteenth day of the illness, there was a sudden drop in the temperature, due to slight haemorrhage, only to return again next motning to 102.6° F. That night it fell to 102.2°, and next motning to 101° F. The following morning (20th day) it fell to normal; and the patient afterwards made rapid progress towards recovery.

Treatment.- As mentioned above, the treatment at the beginning was mainly directed towards reducing the diarrhoea; and, in addition to chalk and catechu mixture given internally, starch enemata with the tincture of opium were administered. Hot poultices were applied over the abdomen to relieve the pain and tympanitis.

It was found in this case that hypodermic injections of morphia (gr.1/6) with atropine (gr.1/180) did most good in reducing the number of motions, and in relieving the excruciating pain. Salol (tabloids of gr.v, one thrice daily) was given as an antiseptic to the intestines.

During the third week, a tonic, containing quinine and aromatic sulphuric acid with a bitter infusion, was administered.

Case 2.

J. S., aged 10 years, complained of headache and bleeding from the nose. The parents had noticed restlessness at night. The child had been peevish for a day or two, had no desire for food, and desired above all things to be left alone to lie in bed.

When taken, the temperature was 102° F.; but when the patient was seen next morning, it had fallen to 100° F. That night, however, it again went up to 102.8 F. This went on, with morning remissions and evening exacerbations for a few days.

The tongue was slightly coated, and the tip and edges were red.

At the commencement of the attack, constipation was present; but, in the course of two or three days, diarrhoea set in, and the stools became typical - i. e., of a pea-soup character. Gurgling and pain were elicited in the right iliac

region.

A few pale-red and slightly elevated spots,which disappeared on pressure,were found over the abdomen and back.There was only a very slight increase in the size of the spleen.

The patient did very well for three weeks,when he developed bronchitis.This set the temperature up again to 103° F.,after it had been about normal for two days;and there now occurred a very troublesome constipation,which had to be relieved by regular enemata.

Treatment.- The patient was kept quiet in bed from the beginning,and put on milk with a little soda-water added. Later on,some beef-tea was allowed.Whey,to which had been added the white of an egg,was also given to the little patient.

At the beginning,a febrifuge mixture,containing the solution of the acetate of ammonium and the nitrous spirit of ether,was given.

Until the patient developed bronchitis,nothing more in the way of medicine,except phenacetin (in doses of four grains) to relieve the headache of one evening,was allowed.

For the bronchitis,a mixture,containing ipecacuanha, squills,and paregoric,was administered.

After the bronchitis had disappeared and the temperature had been normal for ten days,the patient was allowed up for a short time;and he soon made rapid progress towards recovery.

Case 3.

J. T., a gamekeeper,aged 35 years,complained of lassitude and weariness for a few days.When seen,he was found to be suffering from headache,loss of appetite,pain in the limbs and back.

His temperature in the evening was 101° F.,and the condition of his pulse was decidedly dicrotic.

His tongue had the characteristic red tip and edges,with a furred centre.

There was slight diarrhoea,with pain and tenderness over

the abdomen.

About the seventh day,small rose-coloured spots,which completely disappeared on pressure,appeared on the abdomen. The abdomen itself became enlarged and tympanitic;and on pressure over the right iliac region,a distinct gurgling sound was heard.

The spleen was slightly enlarged.

About the beginning of the third week,the patient was delirious at night,and the intellect was dulled.

The temperature was high up to this - viz., 104° F.; but it now began to show marked remissions in the morning,and the diarrhoea was lessened.

In the fourth week,the temperature fell to normal,the diarrhoea ceased,the tongue began to clean,and the patient commenced to cry out for more food:his appetite was simply insatiable.

Treatment.- This consisted in rest in bed from the very beginning of the illness,together with milk and lime-water as the diet.

As the patient began to grow tired of the milk,beef-tea was allowed once a day;but this had to be stopped,as it increased the diarrhoea. Coffee,well diluted with milk,was allowed.

At the end of the second week,two teaspoonfuls of brandy were administered three times a day.

Enemata of starch and opium had to be prescribed for the excessive diarrhoea after the beef-tea.Hot poultices were applied over the abdomen to relieve the pain.

During convalescence,a tonic,containing Easton's syrup, was prescribed.

Case 4.

Mrs. S.,a married woman,aged 33 years,on her return from a three weeks' holiday with some old friends at -------- , where typhoid fever happened at the time to be prevalent, complained of having been suddenly seized,one evening,with

a violent pain in the umbilical region,accompanied by a considerable diarrhoea.

The temperature was 100.5° F.,and the pulse about 100. She complained of headache and thirst.

Next morning,the temperature fell to 99°F.,but went up again at night;and the diarrhoea increased,being of a distinct pea-soup character.

The tongue was furred,with red tip and edges.

As the disease progressed,small rose-coloured spots appeared upon the abdomen and lower part of the chest.These spots disappeared on pressure - only to reappear when the pressure was relaxed.The abdomen became distended,distinctly tympanitic,with great pain and tenderness in the right iliac region.Here gurgling could be distinctly heard;and slight enlargement of the spleen could be detected over the region of that organ.

The temperature rose steadily till it reached 104° F; and there was slight rambling at night.

During the third week,the patient developed congestion of the lungs.

Treatment.- The patient was kept in bed,and put on a milk-diet with two ounces of lime-water to each glass of milk.Albumin-water and egg water were also allowed. Coffee and milk were added to the diet later on.

During the second week,meat broths - previously strained - were administered.

After the patient developed the pulmonary congestion, two teaspoonfuls of brandy were given every four hours.

During the first week, a tabloid of calomel (gr.i),with a tabloid of salol (gr.v),was given as an intestinal antiseptic.

Hot poultices of linseed meal and mustard were applied over the abdomen,in order to relieve the pain in that locality.

For the headache, phenacetine (gr.viii) with caffeine (gr.iiss) had to be given every four hours.

To control the diarrhoea,a mixture, containing the carbonate of bismuth and the tincture of opium,was given.

Case 3.

M. L., aged 37, had been troubled with sleeplessness, langour, and a dull pain in the head, for two or three days. When seen, his temperature - in the evening - was 101.6° F. Next morning, it had fallen to 100°F., only to rise again that night to 104° F.

The patient now complained of great weakness, thirst, loss of appetite, and purging of the bowels - the stools being of a yellow pea-soup colour.

The pulse was quick and feeble, the skin felt hot, and there was swelling of the abdomen with tenderness and gurgling on pressure over the right iliac region. The area of splenic dulness was also increased.

The temperature kept going up at night, and down in the morning - never going above 105 and falling below 102 at these respective times.

At the beginning of the second week, a few rose-coloured lenticular spots, which disappeared on pressure, appeared on the lower part of the chest and abdomen.

On the sixteenth day of the disease, there was a sudden drop in the temperature to 97° F., due to a profuse haemorrhage. Next day, it went up again to 104°F., then fell to 100°F. It afterwards came down, showing marked remissions in the morning.

Treatment.- The patient was kept in bed, and put on milk diluted with lime-water.

As the diarrhoea was excessive, starch and laudanum enemata had to be given frequently.

Quinine (gr.½) was given every four hours to control the temperature.

When the haemorrhage occurred, measures were immediately taken to arrest all intestinal movement. For this purpose, an enema of Dover's powder and tannin was given; and the following mixture was administered by the mouth:

℞

Acid.Gallici ..... gr.ix.

Spt.Vini Rect. ..... ℥i.

Solve et adde

Acid Sulphurici Aromat. .... ℥i

Liq.Opii Sedativ. ..... m.xv.

Aq. Cinnamon. ..... ad ℥vi.

M. Ft.mist.

Sig.- Two tablespoonfuls every Hour for six doses,and then every three hours.

All food was given cold;and iced water was administered to allay the distressing thirst.

A soft,broad, flannel binder was applied firmly around the abdomen.

There was no recurrence of the haemorrhage;and,after four days,the bowels were moved with an enema of olive-oil.

The patient now made rapid and uninterrupted progress to recovery - the convalescence being regulated according to the principles laid down in a previous section of this essay.

Case 6.

J. H., aged 30 years,who had complainedd of feeling out of sorts for a few days,had a severe rigor after being sent to bed.

He complained of severe abdominal pain with diarrhoea; and,when seen,his temperature was 104°F.

His tongue was furred,with the usual red tip and edges seen in typhoid fever.

On examination,the abdomen was found to be tympanitic, with severe pain and tenderness over the right iliac region. There was also complaint of headache and pains in the back and legs.

The pulse,which was 120,was very irregular and dicrotic - the latter condition being especially noticeable.

Next morning,the temperature had fallen to 103°F.; but there otherwise ddd not seem to be much improvement.

During that day, the headache improved a little; but the diarrhoea and abdominal symptoms seemed aggravated, though everything possible was tried to relieve these symptoms.

For the next three days, the temperature remained high (105°F.), and the patient was very delirious at night. The face looked dull, the tongue trembled when protuded, and the general prostration was very marked. The tympanitis increased; and on pressure over the right iliac fossa, the patient winced very distinctly.

At this period there were generally eight loose motions in the twenty-four hours.

The characteristic eruption of typhoid fever could now be distinctly seen - viz., small, elevated, rose-red spots, developing in successive crops, and disappearing on pressure.

During the third week, the fever still remained high, and the delirium became worse. In the intervals of delirium, the patient lay muttering in bed, and appeared to be quite oblivious of his surroundings.

The tongue became dry and brown, and also covered with sordes. The abdominal symptoms became more marked, the tympanitic distension increased, and the diarrhoea became more profuse.

The patient suddenly became extremely pale, and the temperature fell to 97°F. There was severe haemorrhage from the intestine.

The depression of the temperature did not continue long, and next day it rose again to 105°F. The next day again, it fell to 100°F.; and the pain in the abdomen became suddenly worse.

Accompanying this pain, there were signs of collapse, and the patient had a rigor. The pulse was more frequent, and became thready.

Nausea and vomiting came on, and the patient lay with his legs drawn up so as to relax the abdominal muscles. Prostration rapidly increased; and the patient died from peritonitis due to perforation of the intestine.

Treatment.- The patient during his illness was kept quiet in bed,and put on milk diluted with lime-water.About two and a half quarts of the same were administered every twenty-four hours. Albumin-water and egg-water were also allowed.

Brandy,in two teaspoonful doses,was given every four hours,as the pulse was not good;and for the excessive diarrhoea,the following mixture was prescribed:

℞/

Tinct. Catechu ..... ℥iii.

Tinct Opii ..... ℥i.

Bismuth. Carb. ..... ℥iv.

Bismuth.Salicyl. ..... ℥iii.

Mist. Cretae ..... ad ℨvi.

M. Ft.mist.

Sig.- One tablespoonful after every liquid stool.

The following enema was also used:

℞/

Tinct. Opii ..... ℥ii.

Ol. Terebinth. ..... m.x.

Mucil. Acac. ..... ℨii.

For the pain,repeated hypodermic injections of morphia (gr.1/6) with atropine (gr.1/180) were employed.

As a mouth-wash, potassium chlorate (℥i),with glycerine (ℨii) and water (ℨiv) had to be prescribed.

For the tympanitis, from five to ten minims of the oil of turpentine were administered every hour;and a flannel binder - sprinkled with a mixture of equal parts of opium and turpentine liniment - was kept applied to the surface of the abdomen.

When the haemorrhage came on,all food was stopped for several hours.An ice-bag was placed over the abdomen,and the patient was allowed to suck small pieces of ice. An enema,- consisting of ten grains of Dover's powder and ten grains of tannin,mixed with an ounce of gum mucilage,and this again

mixed with one ounce of thin starch,-was injected after each action of the bowels.

When perforation of the intestine occurred, full doses of opium were given in rapid succession (one grain every hour at first),and a binder kept applied to restrain any movement of the intestine.

Case 7.

H. S., a girl of 8 years, had been restless and feverish for a night or two,and complained of headache,diarrhoea,and disinclination for food. There was also bleeding at the nose.

When seen in the morning,the temperature was 100°F., and the tongue was slightly coated.There was tenderness over the abdomen,and also tympanitis and enlargement of the spleen.

When seen again at night,the temperature had gone up to 104°F., and during the day there had been vomiting accompanied by diarrhoea. The stools had a very offensive odour.

During the next few days,the temperature was marked with morning remissions and evening exacerbations.

As typhoid fever was now suggested and suspected,a specimen was taken;and,on the seventh day of the illness, the typhoid serum-reaction gave a positive result.

During the second week, pale-red and slightly elevated spots,which disappeared on pressure,were found upon the abdomen.

Slight tympanitis developed on the tenth day;and there was also now tenderness over the right iliac fossa,together with slight enlargement of the spleen.

From the ninth to the twentieth day,the temperature kept about 104° F., with slight variations.

During the third week,there was an indifference to external surroundings,and an apathetic expression of the countenance.

At the end of the third week,the temperature was normal; and it remained so for ten days,when the patient suddenly had

a relapse. The temperature suddenly went up to 102·F., and kept going up at night and down in the morning,- similar to what it did at the beginning of the disease,- never going above 102.4°F.

This went on for ten days;and,during that time, the patient had a recurrence of the diarrhoea,together with much abdominal pain.

At the end of that time,the temperature came down to normal,and the patient began to show signs of improvement. Convalescence was speedily entered upon,and recovery resulted in due course.

Treatment.- When the patient was first seen,typhoid fever was not suspected;and a diaphoretic mixture - consisting of the solution of the acetate of ammonium (3iv),the nitrous spirit of ether (3iv),the wine of ipecacuanha (3iv),spirits of chloroform (3ii),and water (ad ℥iv) - was given,in doses of one teaspoonful,every four hours.

The patient was put on milk diluted with soda-water, and appeared to digest it easily.

For the headache,a few powders of phenacetine (gr.v) were prescribed,and one ordered to be taken night and morning.

After the diagnosis of typhoid fever was established, baths - at a temperature of 95°,cooled to 75°F.,and continued for twenty minutes were ordered for the high fever.

The patient was kept on the milk;and small sips of cold water were allowed.

During the second week, beef-tea was allowed,the same at short and regular intervals.

For the abdominal pain,a few poultices of linseed meal were applied.

For the diarrhoea, a mixture - containing the carbonate of bismuth, the salicylate of that drug, and the tinctures of catechu and of opium,with chalk-mixture - was administered after every loose motion. An egg,beaten up with a teaspoonful of brandy,was also given daily.

When the patient had the relapse, the poultices were again applied over the abdomen;and a dose of the above mixture was given every four hours.

Case 8.

W. M.,aged 27 years,complained of being feverish, of headache,abdominal discomfort,and of aching pains in the limbs. This condition had lasted for two days.

When seen,his temperature was 102°F., his cheeks were flushed,and his skin was hot and dry. He also complained of having no appetite,and of being very thirsty. His tongue was coated with a thick white fur,and was red at the tip and edges.

On examination of the abdomen,the following symptoms were noticed: pain and tenderness over the right iliac region, with tympanitis and gurgling.There was also enlargement of the spleen.

After the administration of castor-oil,diarrhoea set in. The stools had a very offensive odour,and were of such colour and thin consistence as to resemble pea-soup.

The temperature,which had been gradually rising,at the end of the first week stood at 104° F. at night,and 102° F. in the morning.

About the eighth day,the eruption began to appear on the abdomen and lower part of the chest,and the patient appeared very much emaciated. The pulse was feeble and more frequent.

During the second week,the abdominal symptoms became more marked,and the patient complained more of pain and distension due to tympanitis. The tongue trembled when protuded; and the fever was of the continued type.

On examination over the bases of the lungs with the stethescope,there were marked physical signs of bronchial catarrh.

In the third week the patient was delirious at night;the pulse was very feeble and rapid;and the tongue and mouth were

covered with sordes.

The patient lay on his back,and seemed to take no interest in anything that was going on.

The fever was now more of a remittent type;and,during the fourth week, it became more of an intermittent type,and the patient began to recover.

Treatment.- The patient was kept in bed,and put on milk diluted with lime-water. Afterwards,barley-water was substituted for the lime-water. Albumin-water was also given to allay the thirst.

For the pain,hypodermic injections of morphia (gr. 1/6) with atropine were adminsitered;and hot poultices were applied over the abdomen.

Salol (gr. v tabloids) was given as an intestinal antiseptic, as the odour of the stools was exceedingly offensive.

As the diarrhoea in this case was not excessive, no astringents were given.

A mixture - containing the wine of ipecacuanha, squills, paregoric,and senega - was prescribed for the bronchial catarrh.

At the beginning of the third week, a tablespoonful of brandy was administered every four hours. Chicken-broth and chicken-jelly were also allowed.

After the temperature had been normal for a week, a boiled egg was allowed.

Afterwards, some steamed white fish was given,and the patient allowed to return gradually to his ordinary diet - care being taken at first to give nothing that would leave a large residue behind.

During convalescence, port-wine and champagne were ordered;and a mixture of the ammonio-citrate of iron was prescribed for the anaemia existing.

A change of air helped to complete the patient's recovery

Case 9.

J. S., a male of 50 years, had a severe rigor, and complained of headache, thirst, aching of the limbs, with loss of appetite, and pain in the right side.

When seen, his temperature was 104·F., his pulse quick, and there was rapid breathing, of a shallow character, and a slight cough.

On examination of the lungs with the stethescope, distinct fine crepitations could be heard over the base of the right; and the case was therefore diagnosed as one of lobar pneumonia, and treated accordingly. The temperature, however, remained at 104° F., without any morning remissions.

On the third day, after administration of a dose of calomel (gr.iii), diarrhoea set in; and the offensiveness of the odour of the stools, together with their yellow ochre colour, aroused a suspicion of typhoid fever.

The tongue, which had been furred from the beginning, now began to develop redness at the tip and edges; and the patient complained of pain in the right iliac region.

The base of the lung now became solid, and tubular breathing could be heard over the affected portion.

On the fifth day, the urine gave the diazo-reaction of Ehrlich; and the diagnosis of typhoid fever was confirmed by the Widal test.

Distinct enlargement of the spleen could be felt, as there was not much abdominal distension. A few rose spots appeared on the abdomen, but they were not at all characteristic.

At the beginning of the second week, delirium - especially at night - was a very prominent symptom; and the temperature, - which had never descended below 103° F., - remained high during the whole week. Diarrhoea was very profuse, and had to be controlled by astringent enemata.

During the third week, the signs of resolution in the lung were evident; but the temperature still kept up, and there was not much improvement in the diarrhoea or abdominal symptoms.

During the fourth week, the temperature began to show marked remissions in the morning, and the fever began to

decline.

Although the patient remained very weak,and was much emaciated,he made an excellent recovery in due course.

Treatment.- At the beginning,this case was treated as one of pneumonia;and quinine (in doses of gr.v),dissolved in citric acid,was added to an alkaline mixture and administered every four hours. Hot linseed meal poultices,containing mustard,were applied to the affected lung. The patient was put on milk from the commencement of the attack,and this was diluted with soda-water.

After the suspicion of typhoid fever was confirmed, small doses of brandy and champagne were given alternately.

Salol tabloids (gr.v) were prescribed as antiseptic to to bowels;and,as already mentioned, a dose of calomel (gr.iii) was administered.

Enemata, containing five grains of Dover's powder and ten grains of tannin, were given to control the diarrhoea; and a dose of a mixture contaning the salicylate and carbonate of bismuth,as well as chalk mixture, was administered after every loose motion.

During the second week, it was found necessary to convert the milk into whey,as a good deal of the curd of milk was found in the motions. To this whey was added the white of a new-laid,egg beaten up,and the mixture strained.

Peptonised milk was also given for a change. No solid food was allowed until the temperature had been normal for ten days.

Case 10.

In onset and course,this case differed only from the preceding one in its sequelae and the severity of its manifestations.

A strong and healthy man,with all the symptoms of typhoid fever and double pneumonia, was moribund for days and almost pulseless. He had all the appearances of impending dissolution - e. g., muttering delirium,picking at the bedclothes,etc.

In spite of this,however,he recovered;but all his

mental faculties were greatly impaired. Thus, he suffered from loss of memory,delusions,and peculiarity of manner.

This case was also confirmed as to diagnosis by the Widal test and the diazo-reaction of Ehrlich.

Case 11.

This was a well-marked case of typhoid fever in a mother nursing her child at the breast.

She complained of headache, pains in the limbs, loss of appetite, and lassitude.

Her tongue was coated,and she had slight abdominal pain and distension.

The temperature-chart showed the ordinary characteristics of a typhoid case.

The diagnosis was confirmed by the widal test and the diazo-reaction of Ehrlich;and the patient was kept in bed, and put on a milk diet. In short,nothing special was required in the way of treatment differing from that of an ordinary case of the disease.

In the course of the third week,the temperature fell to normal. After being normal for a week,on the morning of the twenty-eighth day it suddenly rose to 102°F.;and the patient complained of pain in the left leg,with a feeling of tightness and loss of power of that member. On examination, it was found to be swollen and oedematous.

In the evening,the temperature was still high,and it kept so for two or three days - thrombosis of the femoral vein being indicated by the marked increase in the oedema of the leg.

At the beginning of the fifth week, the temperature fell to normal;and the patient afterwards made a splendid recovery.

Though at the breast after the symptoms of typhoid fever had developed in the mother, the child did not take the disease.

Case 12.

In this case, that of a man over 40, the symptoms of typhoid fever were not marked. There was headache, which was at times severe, as well as pains in the limbs, loss of appetite, and a sensations of being very easily tired.

The patient also had only a slight elevation of temperature and a trifling amount of abdominal pain; but the amount of tympanitis present was marked.

There was no diarrhoea - rather the reverse; and there was no enlargement of the spleen appreciable. The tongue was not characteristic of typhoid fever; and the pulse was 90 per minute.

A specimen of the blood was tested for the Widal reaction; but, as it took four hours for clumping to take place, this was not considered satisfactory.

The patient was kept in bed on a fluid diet, and a look-out kept for the rose-spots; but they did not appear. A second specimen of the blood was taken and tested; and this was at once reported positive.

Treatment.- At the beginning of the illness, a dose of castor-oil was ordered, as the bowels were constipated; and this had the effect of producing two satisfactory motions. After this action was over, they again became constipated, though the patient was being allowed beef-tea and mutton-broth well strained.

For this constipation, a simple enema of soap and water - about a pint - was given every second morning, that is to say, when the bowels failed to act of their own accord; and to this was added an ounce of turpentine to relieve the tympanitis. Stupes - equal parts of turpentine and olive-oil - were also prescribed for the relief of this distressing symptom.

For the relief of the very severe headache, phenacetine and caffeine (in combination) had to be ordered.

As there was evidence of cardiac weakness present, whisky and brandy were freely administered, and an occasional

hypodermic injection of strychnine (gr.1/12) given.

A tonic - of strychnine, quinine, and digitalis - was prescribed during the convalescence; and the patient made an excellent recovery.
