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Our Present Knowledge concerning the Ætiology of Typhoid Fever.

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OUR PRESENT KNOWLEDGE CONCERNING THE ÆTIOLOGY OF TYPHOID FEVER.*

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Gentlemen: We have assembled here this evening for the purpose of discussing the ætiology and treatment of a disease which, owing to its general prevalence and grave importance, should be thoroughly understood by the practitioner in medicine. Before I endeavor to present a clear picture of our recent views and knowledge concerning typhoid fever I would intimate that medical nomenclature has not kept pace with our better understanding as to the causation of disease, and in consequence we occasionally miss in the written and oral communications of medical men that sharp distinction existing between a specific typhoid fever and a typhoid symptom.

We all know that the expression "typhoid" (τύφον) indicates drowsiness and cloudiness of the sensorium, and in earlier days was applied to almost all febrile disorders having such typhoid symptoms, so that at the beginning of the present century we find the terms typhoid fever, typhus

* Read before the Medico-chirurgical Society of German Physicians, June 4, 1888.

fever, relapsing and remittent fever, used almost synonymously on account of their common symptom. About the year 1830 Jenner in England and Griesinger in Germany pronounced typhus and typhoid fever as two distinct disorders, the former alone being directly contagious.

This opinion, expressed so many years ago, holds good at the present time, but we know in addition that the typhoid stage or symptom which we frequently observe in acute febrile disorders—as in pneumonia, diphtheria, scarlatina, puerperal fever, or peritonitis—is probably due to a persistent high temperature which accompanies such diseases, and has no connection with typhus or typhoid fever.

If we bear this in mind there will be no necessity for coining such misleading terms as typho-malarial fever, etc.

Definition of Typhoid Fever and its Specific Poison.—For the purpose of brevity we may omit the usual historical retrospect and take up the study of typhoid fever from the time of its recognition as a general infectious disease, defining it as a specific endemic disorder not directly contagious, the poison of which is present in the excrement of the person afflicted. Anatomically, we find swelling and necrosis of certain glandular structures within the intestines. Clinically, we notice prolonged fever, continuous in the acme and remittent in the beginning and the end, with a tendency toward heart failure.

This is not an exact definition, but it will suffice for the purpose of our discussion. The question now presents itself: Are the above-mentioned symptoms occasioned by a purely chemical poison, or is the exciting cause of the infection of parasitic origin?

Is it a chemical poison? No poison, organic or inorganic, fixed or volatile, can produce the above-mentioned (complex) symptoms, or occasions or is accompanied by a

more or less typical fever curve of three to five weeks' duration. No mineral poison, none of the numerous poisonous vegetable alkaloids, neither cyanides nor any other poisonous compound obtained by synthesis, can produce symptoms similar to those of typhoid fever. All the well-known poisons most rapidly destroy life when taken in sufficient quantity, and occasion little or no disturbance if taken in diminutive doses. A propagation of a purely chemical poison within the body, accompanied by characteristic symptoms extending over a long period of time, is an impossibility. As long as the normal functions of the tissues are not materially interrupted, elimination follows; otherwise death speedily results.

Even the isolated ptomaines do not, to my knowledge, provoke prolonged and typical disease; they react upon the animal economy precisely in the manner of organic poisons in general. The same is true of the toxic gases; neither marsh-gas nor sewer-gas produces typhoid fever.

We might conceive of a volatile cause of typhoid fever by assuming the body to be exposed to its influence during the whole period of sickness. But such an assumption is rejected at once if we reflect that a patient after infection fails to escape the disease by withdrawing from the place of infection. Even were you to hasten him from New York to the North Pole, the disease would surely run its course. I know of a woman who was taken sick with typhoid fever in a small town near Wiesbaden, Germany, a few days prior to her departure for New York. She was sick on board the steamer, and remained sick for three weeks after the completion of her journey; and I suppose almost every physician is familiar with cases of that nature.

Accordingly, we may say that the poison of typhoid fever is not a chemical poison, for, *a priori*, its reproductive ability both within the system and external to the body, its

intimate connection with putrefaction, the typical course of the disease—all these are indicative of its parasitic origin. The *modus operandi* may be expressed as follows: A specific parasite has the power of inducing putrefaction in a tissue wherein it is lodged and thereby produces a ptomaine. This organic poison is absorbed, produces symptoms of disease, and is finally eliminated; the system is therefore under the influence of a poison as long as its production within the body lasts. After several weeks the activity of the specific parasite reaches its limit and the production of the ptomaine ceases; thus we have an illustration of an acute infectious disease. That the vitality of a parasitic organism reaches a natural limitation is a palpable conception, and it has been suggested that many of the microorganisms may limit their own activity by the high body temperature which they induce. This may be quite true in many instances, but there are exceptions, for we know that the *Bacillus tuberculosis* thrives admirably notwithstanding the high and continuous fever which many phthisical subjects have.

What other proofs have we that the poison of typhoid fever is a *contagium vivum?*

The discovery of the specific bacillus is credited to Eberth and Koch. In 1880 Eberth described a species of bacilli present in recent cases of typhoid fever in non-ulcerated, enlarged intestinal follicles—Peyer's patches—spleen, liver, kidneys, lungs, intestinal lymphatics, and the central nervous system. The cultivation gave the best results in potato medium, and, according to Gaffky ("Mittheilungen aus dem Gesundheitsamt," Band ii), the potato cultivation of this bacillus is so characteristic that it may readily be distinguished from others by the naked eye, and is looked upon as a means of diagnosis. E. Fränkel and Simmonds sought to prove the specific pathological nature of the "typhoid"

bacillus by animal inoculation. The later investigations of Beumer, Peiper, and Serotinin ("Zeitschrift f. Hygiene," Bd. i–iii) show that the evidence of inoculation is not absolutely conclusive, but still so satisfactory that these authors recommend prophylactic vaccination. The bacillus described by Eberth has occasionally been found in contaminated drinking-water and in milk; however, it is thought that such milk had been watered.

V. C. Vaughan, M. D., and F. G. Novy, M. S. ("Med. News," January 28, 1888), profess to have been the first to discover the bacillus of Eberth in this country, in an article entitled "Experimental Studies on the Causation of Typhoid Fever." A sick immigrant introduced the disease into Iron Mountain, Michigan. From August to December statistics show three hundred and fifty cases with 10 per cent. mortality. The presence of the bacillus in the drinking-water was demonstrated by the potato cultivation, and it was also found in the tissues of some of the patients.

We may therefore state that the evidence as to the parasitic origin of typhoid fever is conclusive.

Next in importance to the recognition of a poison, its source is of practical value, for if we know from what direction danger threatens we have a rational defense in prophylaxis.

If we at any time admit the existence of a specific parasite we must also admit its continual propagation, and it is not at all probable that the typhoid-fever poison originates spontaneously in putrescible matter, but that it finds therein a suitable vehicle for its growth and multiplication. In other words, drinking-water contaminated by drainage from a cess-pool will not cause typhoid fever unless the specific germ is contained therein.

Experience has taught us that the disease under con-

sideration is not directly contagious, and we know, on the other hand, that the specific poison is contained in the dejections of the sick; therefore we may state, without fear of contradiction, that the *carriers of the contagion are chiefly air, water, food, clothing*, and, as I personally believe, the *clinical thermometer* in hospital wards.

It is hardly necessary to cite instances of infection by means of contaminated air (sewer-gas), the latter being simply a vehicle for the typhoid-fever germ.

Murchison has reported how a number of children were taken sick from breathing the air of a school-room contaminated by means of an open cess-pool. Nearly all the children were attacked, and those sitting nearest the closet were taken sick first. A positive proof of infection by means of sewer-gas has lately been reported. Some time ago several convicts were stricken with typhoid fever in one of the wards of the Michigan State Prison at Jackson. The Board of Health was called upon to investigate the matter under the supervision of Professor Vaughan, director of the Michigan Laboratory of Hygiene. The milk and the water supply were found pure. A defective sewer was found which had not been in use, but which communicated with a newly constructed sewer under the hospital ward. The air of the old soil-pipe was analyzed and the typhoid-fever germ found, and distinguished by the potato cultivation ("Sanitary News," February 8, 1888).

When air or sewer-gas is the medium of infection, absorption of the poison need not necessarily take place through the lungs. In all likelihood the germs are caught in the secretions from the naso-pharyngeal space and are swallowed.

Infection by means of drinking-water is a well-established fact and need not be dwelt upon. Occasional immunity is noticeable, but sooner or later finds its explana-

tion. Dr. Underwood, customs medical officer at Kinkiang, China, noticed marked immunity from the disease among the natives in his district, notwithstanding the frequency of typhoid fever among the Europeans located there. He explains this by the fact that the Chinese drink no water while tea is at hand.

According to Billings and Prudden, impure ice may be the means of infection ("The Medical Record," April 2, 1887). Dr. Prudden states in his article that there are a considerable number of cases of typhoid fever in which the most painstaking examination of the sanitary surroundings of the victims and their personal contacts fails entirely to account for the occurrence of the disease. Some of these isolated cases of typhoid fever, whose origin is otherwise unaccountable, may well be due to the ingestion of bacilli from sewage-contaminated ice.

Contagion by Clothing.—The Berlin correspondent of the "Medical Press," March 28, 1888, reports a persistent epidemic that played havoc in a garrison artillery barracks from 1873 to 1885. A case of typhoid fever was imported in 1873, and from that date to the close of the epidemic 146 cases occurred. Every possible source of disease was looked into and everything kept in the best possible condition, but the disease baffled all inquiry. The closing of the barracks finally came up for consideration, but previously suspicion fell upon the bed-linen and clothing, because the vast majority of cases were furnished by the men of one battery alone. On close investigation, it was found that the linings of the trousers were, almost without exception, soiled by dry fæcal matter. The clothing was submitted to renewed careful treatment by means of chlorine and dry heat, from which time (November 18, 1885) no more cases of disease occurred.

Infection by means of the clinical thermometer in hos-

pital wards, and through nurses who attend a typhoid-fever patient at one moment and presently prepare ice-water without previous disinfection of their hands, is a sure thing, in my opinion, and the possibility of its occurrence should be borne in mind and avoided by all means.

Local and Individual Disposition.—We have all read, or attempted to read and digest, the somewhat lengthy treatises on ground-water, the height of which is calculated according to the depth of well-water. As a matter of fact, ground-water stands in a certain relation to health, and Pettenkofer has found that typhoid fever is prevalent with low ground-water. The investigations of B. Latham, C. E. ("Popular Science Monthly," December, 1887), extend over a period of eleven years, and show for England the prevalence of typhoid fever *after* low ground-water.

On general principles, I should be inclined to hold that contaminated well-water would contain proportionately more germs if the well were nearly dry than if it were quite full.

Finally, it should be borne in mind that high temperature favors the development of typhoid fever.

Individual Disposition.—Concerning individual disposition little is known. Persons between fifteen and thirty years of age are most liable to be taken sick; the disease attacks more men than women, more robust than weakly individuals. It is the exception that one person is attacked more than once. I can, however, recall several such cases. Occasionally entire families are stricken with typhoid fever. In 1878, of a family of eight persons living at 113 Eldridge Street, all were attacked within four months, and all fortunately recovered.

The following cases are also of interest:

In 1878 I was called to attend a cigar manufacturer, living with his second wife and six sons in East Fourth

Street, New York. About a year previous his first wife had died of typhoid fever in the same house. One of the sons was sick with typhoid fever and got well after severe illness. Six months later a second son became sick and died. Subsequently the family removed to a flat in St. Mark's Place, and in October, 1887, the whole family except the stepmother contracted typhoid fever, and all recovered; thus one of the sons had the disease twice. A sister of the head of this family, residing at Sing Sing, reports that within a few years she and two children have been sick with typhoid fever. Under such circumstances one may well speak of individual disposition, whatever that may be.

The diagnostic value of the "typhoid" bacillus deserves a passing notice.

Microscopic examination is insufficient for the purpose of diagnosis, the potato cultivation being necessary under all circumstances. Typhoid-fever stools should not be used for obtaining cultivations, as they contain many varieties of bacilli. The examination of peripheral blood usually yields a negative result. Lucatello has removed blood from the spleen with a Pravaz syringe and obtained cultivations in ten instances out of thirteen. The blood of "roseola" patches gives a positive result in 50 per cent. of cases. A diagnostic bacteriological examination consumes several days, and is therefore of little value as a preliminary procedure, because the clinical diagnosis is usually made in about the same time.

Such an examination may be of importance, however, in distinguishing between typhus fever, typhoid fever, acute miliary tuberculosis, and other forms of disease accompanied by a constantly high temperature. The precise relation of typhoid fever to those forms of disease which are similar but of a very mild type has not as yet been cleared up.

In conclusion, I would add a few words on the prophylaxis of typhoid fever.

Dr. Vilchur, of St. Petersburg ("Lancet," January 14, 1888), has found by experiment that boiling water kills the "typhoid" bacillus, and recommends that the stools of patients be treated with boiling water. Such a method is impossible in private practice for obvious reasons; nevertheless, the physician should insist that the stools be treated by some cheap disinfectant, also the soiled wash.

No sleeping apartment should have a wash-basin which communicates with drain-pipes and sewers. The occasional use of germicide solutions in waste-pipes is no safeguard against infection; it is far more advisable to place a large piece of crude potash into the sinks every week or two; the fatty and sticky coating on the interior of waste-pipes is thus dissolved and loosened up and is carried away by a flush of water. Such a procedure would work good results, especially in tenement-houses.

According to our present experience, infection through drinking-water can be avoided by boiling the water before use.

In the tenement-house districts of New York city typhoid fever would have fewer victims if the physician who attends a case would make it his business to ascertain that printed directions distributed by the Board of Health to prevent the spreading of contagious disease were actually read, understood, and obeyed.

Many people are willing to carry out sanitary instructions if they are shown how; others neglect to do so because they do not quite understand written instruction, and no one has a better opportunity to make such matters clear than a conscientious attending physician.

Clinical thermometers after use should be cleansed

with a pledget of cotton and bichloride-of-mercury solution.

To what extent the physician may be able to counteract the intensity of the poison, limit the duration of the disease, and keep the body functions as near as possible to the normal standard during a period of disturbance, is a matter of therapeutics.

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