telligence and passivity may permit the detailed routine of an exactly applied scientific performance, such as we now cannot, if we would, secure. Until that time comes, the word of sense and sympathy must not be supplanted by the last one upon which science has placed the stamp of approval; and during this rapid evolution of medical progress our duty is simple,—to attempt to think logically and sanely with such humble powers of observation as we may possess.

In the consideration of some of the doubts and perplexities that every conservative physician must entertain, there should be no morbid pessimism about the future; we do a double duty in each problem solved in making as individuals for the continued progress of medicine; yet there should not be a too great readiness to detect disease, lest we become incapable of receiving all the evidence, having our thought concentrated upon some new infallible method of our own or another which may seem to surmount old-time difficulties and give a sense of security and knowledge. While diagnosis is the most essential demand in our work, it should not make us careless of the growing cry for the cure of every condition or disease to which our bodies may be subjected; the important consideration of treatment may be neglected; we take the patient readily and gladly into partnership and discuss volubly the scientific aspect of his case, contentedly feeling that we have vindicated our conclusions beyond any questioning thought. This attitude of what is most essential is from our own view-point; the problem and the accuracy of its solution, while vital in the quest of perfect knowledge when possible and the necessary forerunner of intelligent treatment,—coöperation of the patient and the maintenance on his part of a lively sense of the result to be obtained, while comforting and stimulating to the physician, do not constitute the whole perplexity that confronts the patient; the refinements in methods are of less interest to the subject than their results. His appeal, and his trust in that appeal, should leave but one fixed purpose,—his mental or physical relief; and the downright heartiness of that endeavor requires a sagacity acquired in no one of the physician's many workshops of learning.

We are gradually acquiring through the natural development of the processes of medical growth a system for the scientific management of disease. The past is full of stimulating traditions; the present, filled with the grains of precious wisdom that have been extracted from the mountains of theory and conjecture; and we accept the truth that in the future what we now worship will be swept away in the melting-pot of scientific ardor. But in admitting our limitations, we affirm with greater confidence our optimisms. It is only when harassed and perplexed that men learn; "strength grows out of weakness." The ideal of medicine demands for its consummation, individual exertion and un-

tiring enthusiasm. Each contribution, whether of the laboratory,—from the special research man,—or of the great hospital and private clinics, from the more practical observers and teachers—successful practitioners of well-deserved repute,—or of the storehouse of experience, from the great class of silent, thinking medical men,—each factor is an atom, akin to the body of the tiny coral insect, in the building of the enduring structure of the "Goddess of Medicine."

The poet sings,—

"Grandeur of the perfect sphere
Thanks the atoms that cohere."

And of the cohering elements entering into the structure of medicine by no means the least valuable is the country practitioner, who, alone and remote from all enthusiasm and support, often surrounded by unsympathetic critics, goes ahead and does his work as he sees it.

It is easy to be a soldier when you have a soldier on every side of you; over-courage is born of the crowd; but the yeoman service is his who, enduring—

"Chance and victorious death,
Life and his doom obscure,"

learns the secrets of sickness from his lonely struggle with it.

To support, not suppress, this type of man should be our objective; to assist his patient observations of his patients' symptoms and story with rational laboratory research should be our ideal.

Original Articles.

THE RELATION OF BACTERIA TO THE ETIOLOGY OF SUMMER DIARRHEA IN YOUNG CHILDREN.*

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THE subject for discussion this evening is one that has stimulated much controversy, and the final solution of the problem is apparently remote. The object of this presentation is to point out certain features of the problem which have caused confusion in the past and to mention briefly certain unusual observations which may have led to erroneous conceptions of the part played by bacteria in the causation of acute diarrheas. To avoid ambiguity at the start, only those severe summer diarrheas will be considered in which the pronounced clinical symptoms are

* Presented before a meeting of Pediatricians of the Middle West, Oct. 29, 1914.

observed to be fever, prostration, vomiting, and, frequently, nervous symptoms, together with mucus in the movements, often associated with pus, or blood, or both. The movements *per diem* are increased in number and reduced individually in amount.

Many theories have been advanced to explain the etiology of these summer diarrheas, some of them very elaborate and comprehensive,—but for purposes of debate the underlying principles of these theories may be reduced to three rather distinct groups. It is to be definitely understood that these three respective theories attempt to explain only the initial cause of the diarrhea in each instance; secondary complications which may arise during the course of the disease are eliminated for the moment.

1. The Meteorological Theory. This theory assumes that high temperatures experienced during the summer months, usually in association with high relative humidity, initiate nervous and metabolic disturbances of greater or lesser severity, particularly in young children, which lead to the train of symptoms just mentioned.

2. The Physiological Theory. According to this theory, dietary indiscretion, or perhaps the temporary inability of the young child to assimilate food, is the primary inciting factor of diarrheal disturbance. This dietary indiscretion, which may be further complicated by secondary, endogenous bacterial involvements, leads to nervous and metabolic disorder, as well as an intolerance for certain types of food, carbohydrates and salts appear to be the more common food elements which lead to this syndrome, according to the most widely accepted of these physiological theories.

Both of these theories—the environmental and the physiological, tacitly assume that the patient is not a source of danger to other children, for there is nothing inherent in either of these theories which would point to infection with exogenous bacteria. Endogenous bacteria do not, as a rule, cause progressive disease from man to man.

3. The Bacterial Theory. This theory, as the name implies, asserts that specific bacteria, or combinations of bacteria, are the primary etiological agents of certain of these diarrheas. The bacterial theory presupposes that a specific organism, or association of organisms, is actually identified before the diagnosis is arrived at. The

patient, according to this theory, is a potential menace to other children.

There is no doubt that each of these theories best explains a certain proportion of these diarrheas, and it is equally probable that combinations of heat, food and bacteria are responsible for many others; furthermore, from season to season, one or another theory may be found to be the more important factor in a majority of the cases under observation. Doubtless, also, as more exact information becomes available, it will be found that sectional differences of opinion which prevail at the present time will be reconciled, and that these differences may be attributed reasonably, in part at least, to actual differences in the material under observation in different places. Indeed, there is strong presumptive evidence that the summer diarrheas seen most frequently in Germany differ in type and severity from those which have prevailed in the past in the large cities along the Atlantic coast of the United States. A very simple explanation presents itself. Cow's milk is a very cosmopolitan children's food both in this country and in Germany; in Germany milk is customarily boiled before it is fed to infants and young children, whereas in the United States, in the East at least, it is not boiled as a rule; in fact, it is only comparatively recently that pasteurization has been generally introduced in this country. Milk is a particularly good vehicle for the transmission of bacteria, and it is a significant fact that the majority of disease-producing organisms which may be thus transmitted through it from man to man are those whose portal of entry is the gastro-intestinal tract. When one recalls that the type of disease under discussion is probably gastro-intestinal in origin, it is not surprising to read that bacillary dysentery and similar diseases of bacterial causation are comparatively rare in Germany; the organisms causing this type of disease are non-spore-forming, and, therefore, readily killed by the boiling temperature to which milk is subjected there. On the contrary, bacillary dysentery and similar infections are, or were, relatively common in the eastern part of the United States, where in the past the "dip tank" no doubt contributed a formidable amount of infection to and through the poorer classes, whose poverty necessitated the purchase of small amounts of milk at one time. It should be remarked parenthetically that the more general pasteurization of milk and the activities of the Infant Welfare

Stations have been accompanied in this country by a marked reduction in the incidence and severity of this class of disease, which no longer appears endemically summer after summer as formerly, but rather tends to appear sporadically. The bacterial diseases transmissible through milk in Germany would theoretically be caused by spore-forming bacteria, and it is a significant fact that the most common treatment of severe feeding cases in that country, administering Eiweiss Milch, is essentially the one which experience has shown to be efficacious in the United States for the treatment of at least one perfectly definite infection by a spore-forming bacillus which is transmitted in milk—the “gas bacillus” (*B. aerogenes capsulatus*). Indeed, cases are on record where infection with this organism has developed in hospital wards following the administration of lactose, which was found subsequently to contain a large number of spores of the “gas bacillus.” This is not to be construed as a suggestion that all the feeding cases and diarrheal cases seen in Germany are due to the gas bacillus,—probably the reverse is true in the majority of cases.

Returning once more to the discussion of the theories of summer diarrhea, there are occasional cases of sudden severe illness, frequently with a temperature of 102-103°, marked prostration, vomiting, and diarrhea, which respond promptly and favorably to suitable changes in environment, together with the withdrawal of all food for 24 hours, if these patients are seen in time. These cases are encountered not infrequently in excessively hot, humid summer weather; their prompt response to proper changes of environment suggests strongly that the chief etiological factor is environmental, namely, heat and humidity. Ordinarily these cases are not numerous.

Dietary indiscretions are undoubtedly far more common causes of summer diarrhea. Uncomplicated cases, provided they are seen early, usually show decided improvement within 24 or 48 hours following the withdrawal of all food; the temperature abates, and the acute symptoms subside, although they may, and not infrequently do, develop into more or less chronic “feeders” with persistent abnormal movements.

The severe bacterial infections differ from the preceding types in one important particular, so far as fever is concerned. Even if the patient is

seen in the early days of the disease, the fever persists for several days, in spite of the withdrawal of food, and the substitution of a proper environment. The patient usually becomes progressively worse, for a time at least.

The most annoying physical features of severe diarrheas of bacterial causation is the similarity of clinical symptoms elicited when widely different types of bacteria are the etiological agents; the general clinical response to infection on the part of the patient gives little definite evidence of the nature of the invading organism. The symptoms overlap, as it were, and for this reason it is necessary to resort to other than purely physical signs to establish the correct bacterial diagnosis. This is particularly true of severe infections; mild infections may so closely simulate the symptoms of dietary indiscretion, of thermic fever, that a definite diagnosis is frequently not made.

This leads to a very important question: How differentiate the three types of diarrhea, and what value has a bacterial diagnosis in this connection? A bacterial diagnosis presupposes the services of a well-equipped laboratory, which is not always available. In the past, furthermore, a bacteriological diagnosis, even if it were made properly, has done no more than to catalog certain bacteria which are presumably the cause, directly or indirectly, of the disturbance. The chief value of such work has been to furnish names for certain types of disease, thus adding definiteness to the diagnosis, and to warn the clinician that the patient is a potential source of danger to other individuals. Thus the net result of such an examination is diagnostic and preventive; the all-important factor to the patient—the suggestion of a definite line of treatment—which is at least theoretically desirable—is not touched upon. Undoubtedly this paucity of information has led many clinicians to frown upon the laboratory, they believing with a great deal of reason that the laboratory examination is not worth the trouble expended in obtaining it, and the tendency has been for empiricism to replace laboratory investigation. It is a noteworthy fact, however, that empiricism, based upon keen and extensive observation, very frequently leads to the same general action as would the more direct laboratory investigation; indeed, the practice of medicine has been largely developed by this empirical method.

There are certain peculiarities in the seasonal distribution of types of bacteria which cause summer diarrheas, which have tended to restrict empiricism, at least as it may be applied in the treatment of the more severe cases. Instances of this are well known; at one time or another every combination of milk proteins, milk sugar, whey, and cream have been used with varying success in the treatment of severe diarrheas one season, only to fail in whole or in part the next season. A specific example may make this assertion more definite. A large series of sick babies were treated indiscriminately with a preparation which was potentially buttermilk during an entire summer. The cases were not selected other than that they were all of the diarrheal type—mild or severe. At the end of the season these cases were collected and summarized, and the information gleaned from this treatment was placed on record for the benefit of those interested in the subject. The report was accurate in every respect and striking enough to induce others to try the same procedure the following summer. The results obtained the second season were disappointing, almost without exception. How is one to interpret this apparently paradoxical situation? A very direct and satisfactory explanation presents itself when the bacteriological aspect of these cases is unfolded. It has been stated that different types of bacteria may elicit the same general clinical response in young children—hence the similarity of symptoms observed during the two years is plausibly accounted for. The predominating organism isolated from the patients the first summer was the "gas bacillus," an organism which is more active in the intestinal tract when carbohydrates are present; the activity of the gas bacillus is considerably restricted, however, when protein replaces the carbohydrate of the diet. The addition of lactic acid to the diet appears to reinforce the favorable results obtained by feeding protein and restricting sugars. Buttermilk, properly prepared, combines the advantages of a protein diet and lactic acid. The patients seen the next summer differed bacteriologically from those of the first summer in that the dysentery bacillus was the dominant organism encountered, not only in the severe diarrheas, but in some mild cases as well. The "gas bacillus" had largely disappeared; only a comparatively few sporadic cases were found. The dysentery bacillus is habitually a proteolytic organism; it produces its poison, according to various investigators, chiefly, or only, in the absence of utilizable sugars. The presence of utilizable sugar in the intestinal tract tends to change the metabolism of the dysentery bacillus in such a manner that these poisons are either not produced, or produced in lesser amounts. Buttermilk has little or no influence in restricting the activity of this organism; indeed, buttermilk appears rather to aggravate the conditions in the intestinal tract, particularly in the more severe cases.

This explanation of the success and failure of buttermilk, as the type of dominant infecting organism shifted in two successive years, is probably not unique; it is possible that other, similar observations may be made in the future. It might be objected that the gas and dysentery bacilli, respectively, were not necessarily distributed seasonally throughout the country as they were in the East, thus weakening the argument somewhat. This objection cannot be definitely answered pro or con with our present knowledge, but for the relatively limited area in which this observation was made the explanation appears to be a valid one. In any event, it is obvious that the etiology of these diarrheas for the two successive years described could hardly be attributed to dietary indiscretion alone. If such were assumed to be the case, one would be forced to assume that there may be among young children a seasonal food idiosyncrasy which in the instance cited resulted in a rather general carbohydrate intolerance one year and a corresponding protein intolerance the next year.

A seasonal distribution of bacterial types appears to have been unrecognized hitherto, at least in association with diarrheas in infants, and a brief discussion of studies along this line made during four consecutive summers on the Boston Floating Hospital will illustrate more clearly how the dominant type of organism found there in cases of summer diarrheas varied from year to year.*

During the summer of 1910 by far the greatest number of severe diarrheas which entered the wards were those from which dysentery bacilli, either of the Shiga or Flexner type, or both, were isolated.

TABLE I.

Year.	Total Cases Examined.	B. Dysenteriae Shiga and Flexner.	B. Aerogenes Capsulatus.	Streptococcus.	B. Morgan.	B. Paratyphosus Alpha and Beta.	"Slimy" Bacillus.	B. Proteus.	B. Alcaligenes.
1910	52	39	22 ¹	7 ²	4	beta 2	0	0	1
1911	146	18 ³	33 ⁴	78	16	alpha 1 beta 10	2	8	5
1912	135	5	53 ⁵	6	13	beta 4	31	2	3
1913	457	35 ⁶	53 ⁷	5	29	beta 8	59	2	4

¹ 293 cases examined: 6 normal, 2 watery stools, 14 blood, pus and mucus.

² Organisms also found in variable numbers in 60% dysentery cases.

³ 3 undoubted carriers—no gastro-intestinal disturbance.

⁴ 283 cases examined;

⁵ All showed blood, pus and mucus in stools: majority of cases severe.

⁶ 18 carriers—mild diarrhea.

⁷ 11 severe cases; remainder symptoms mild.

* This great charitable institution draws its patients from the poorest and most crowded parts of the city; hundreds of cases are treated each summer, and a majority of the cases are severely or even desperately ill. Many patients have died as they were carried across the gang-plank, or shortly after they entered the wards; the little patients are only too frequently brought to the hospital so late that nothing can be done for them. The mortality from bacillary dysentery during "bacillary dysentery years" has been from 85 to 50% of all cases diagnosed.

In 1911, although the cases were apparently equally sick and the general clinical picture was about the same, dysentery bacilli were comparatively rarely found in the movements; streptococci, on the contrary, were very abundant. Pure streptococcus infections had not been met with in 1910. The sequelae of the severe diarrheas in 1911, furthermore, were those which would suggest a streptococcus etiology: general septicemia, acute nephritis, involvements of the middle ear, two cases of perforation, and peritonitis.

In the summer of 1912 a new organism was dominant, although occasional sporadic cases had been met with during the two previous years. This organism was *B. aerogenes capsulatus*, or, as it is more popularly called, the "gas bacillus." Typical severe gas bacillus cases present a clinical picture which is strikingly like the syndrome of true bacillary dysentery, but with this very important distinction. Sugars are not only well borne in dysentery cases; they appear to be of some material assistance in tiding over the sick patient. If the same sugars were fed to patients suffering from "gas bacillus" diarrhea, which, it will be remembered, present the same general clinical syndrome, it will be found that far from being well tolerated, these sugars are distinctly harmful. Following the administration of sugar to such patients, the temperature is rapidly increased, only to fall slowly to its original level when the sugar is withdrawn. That is to say, as desperately sick dysentery patients are intolerant of protein, so desperately sick "gas bacillus" patients are intolerant of carbohydrates.

The following year (1913) another organism, belonging to the capsulated group of bacilli, made its appearance. This organism appeared to be far less active in producing severe diarrheas than were either the dysentery bacilli, the streptococci, or the gas bacilli, and the general run of diarrheas this particular season was noticeably less severe in character than those met with in previous years. These capsulated bacilli were found in a very large proportion of the diarrheas seen in 1913. These bacilli, furthermore, were found to be rather widely disseminated in nature during that summer, not only in the intestinal tracts of babies, but even in certified milk, where they formed at times from 60 to 75% of the total bacterial count of such milk; in the majority of instances this bacterial count was within the 10,000 limit standard imposed in Boston. It was noticed that diarrheas actually developed in the wards when this milk was fed; these capsulated bacilli were invariably found in the movements. The simple expedient of boiling the milk, however, not only prevented further development of these cases, it also appeared to help materially in treating the cases which entered the hospital. The assumption was that the capsulated bacteria did not readily acclimatize themselves to the intestinal environment.

The question is not infrequently asked, how does one know that dysentery bacilli, strepto-

cocci, gas bacilli, or capsulated bacilli are the probable causes of these diarrheas? The evidence in the case of the dysentery bacillus is fairly convincing. Tremendous epidemics of bacillary dysentery have occurred in Japan in the past, and a few laboratory accidents are on record in which laboratory workers have accidentally swallowed dysentery cultures and have subsequently developed typical cases of bacillary dysentery. There is a certain amount of evidence also which would indicate that children have developed bacillary dysentery in hospital wards apparently from other patients. More direct evidence is furnished by a few cases from whom the dysentery bacillus has been isolated directly from the blood stream before death. At least three authentic cases are on record. Finally, at post-mortem examination, the lesions of bacillary dysentery are characteristic and agree in essential details with those observed in the fatal cases in Japan, and the serological reactions are specific and characteristic.

The evidence pointing to the streptococcus as the etiological agent of one type of diarrhea is somewhat less direct. Finding the organisms in unusual numbers in the movements unassociated with other pathogenic bacteria, and the complications, particularly septicemia, nephritis, and middle ear infections, in which the streptococci are recovered from the blood stream or from internal lesions, furnish the principal evidence. It should be remarked parenthetically that these complications are usually not found in dysentery or gas bacillus diarrheas, although streptococci are undoubtedly present, frequently as secondary invaders, in true bacillary dysentery infections. The post-mortem lesions of streptococcus diarrheas are quite different from those of bacillary dysentery, although the symptomatology is much the same in the severe cases.

With respect to the gas bacillus, a few post mortems that have been obtained did not exhibit intestinal lesions which suggest either those of bacillary dysentery, or streptococcus infection. The striking macroscopic lesion appears to be for the most part a necrosis of the solitary lymph follicles of the intestinal tract, but these lesions are so limited that one wonders where the large amounts of blood, pus and mucus, which are a feature of the movements of these cases, originate. One of the most striking physical features of a gas bacillus infection is the curious and usually definite response on the part of the patient to the feeding of sugar. The response of gas bacillus cases to protein diets, including buttermilk and Eiweiss Milch, brings them into prominence in comparison with the experiences of Germany and parts of the United States. The gas bacillus is one which thrives on carbohydrates, and its activity is greatly increased by the presence of sugars. Consequently, it is not surprising to find that babies having well-defined gas bacillus diarrhea are harmed by feeding of sugars. The clinical manifestation of this insult is a rather prompt and decided rise in tempera-

ture. The withdrawal of sugar and the substitution for it of protein, or, better, buttermilk, which contains considerable amounts of lactic acid, not only tends to bring the temperature back to a point approaching normal, but also to bring about a rather marked and comparatively rapid improvement in the symptoms. It is worthy of note in this connection, furthermore, that the gas bacillus which thrives on carbohydrates in the intestinal tract does not produce symptoms of toxemia in uncomplicated cases. Its effect on the patient in this respect is markedly different from that of the dysentery bacillus in which toxemia is a prominent factor. The effects of the severe toxemia, which is a feature of severe dysentery cases, persist after the cause of the toxemia is removed; many of these patients are unable to rally and eventually die from the effects of this toxemia in spite of treatment. The line of demarcation, clinically, between toxemia and extreme prostration is not sufficiently noteworthy to make this a very important diagnostic point, particularly in young children. It might be remarked parenthetically that evidence is accumulating which would indicate that the gas bacillus may be a more important organism in producing disease than has been generally suspected. It was first recognized as the cause of gaseous phlegmon, but evidence is available now which would indicate that at least in certain years it is a potent factor in the production of severe gastro-enteritis, not only in children, but in adults as well, and that in adults particularly it may lead to chronic intestinal disease, which may be accompanied after considerable periods of time with symptoms suggesting arthritis. The organism in a somewhat modified state of pathogenic activity has been actually isolated from at least one case of middle ear infection and from a case of chronic hypertrophic tonsillitis.

The gas bacillus is ordinarily regarded as an organism which is invasive, and the gaseous phlegmons referred to above are striking examples of such invasion following traumatism. Their activity in the intestinal tract rarely, if ever, leads to general systemic invasion. A certain amount of indirect evidence in favor of this view is afforded by the intravenous or subcutaneous introduction of dextrose into the body. If such a sugar is *fed* to the patient, it meets the gas bacilli in the intestinal tract with an almost immediate response on the part of the patient, shown by a rise in temperature. Sugar introduced *parenterally* into the body does not produce such a rise, even though large numbers of gas bacilli are active in the intestinal tract.

The discussion so far has related chiefly to the bacteriological diagnosis of certain types of summer diarrheas, and the evidence presented in connection therewith has related to the clinical and pathological features of these cases, which appear to confirm these opinions. An explanation of the seasonal alternation of dominant bacterial types is not so readily accounted for. Whole-

sale active immunization of the population from year to year could hardly explain the facts, for many of the patients under observation each summer were less than one year of age.

It is necessary to turn for a moment to the natural history of disease for a possible explanation of these alternations of bacteria. From time to time there have occurred world-wide pandemics of certain bacterial diseases. One of the most noteworthy of these is that great pandemic of influenza which swept over the world some three decades ago. This pandemic was a very widespread one with many fatalities. It will be remembered that it appeared first in Russia, it swept west to the Atlantic seaboard, appeared some two weeks later in the eastern Atlantic cities, crossed the American continent, crossed the Pacific to the Orient, and finally came back to Russia. In any geographical area the disease appeared suddenly and disappeared with comparative rapidity. It left in its wake sporadic cases which, however, for the most part have never become foci of new pandemics or epidemics. Rather, the residual organisms have become "opportunists," as Theobald Smith has expressed it, not producing acute epidemic disease, but appearing for the most part in sporadic cases or as secondary invaders. Pandemics are not very common.

Passing to diseases which are endemic, as typhoid fever, it will be found that there is a tendency for typhoid to become epidemic during certain years, that is to say, at irregular intervals typhoid fever increases either locally or generally. This same generalization is applicable to all endemic diseases, except the slow-growing diseases, as tuberculosis and leprosy. All endemic diseases, in other words, and those diseases which occasionally become pandemic, tend to wax and wane. More and more attention is being paid to the residual sporadic cases and bacillus carriers which are left in the wake of these epidemics, as it were, and which may be potent starting points of fresh outbreaks. Many instances are on record where such carriers have become foci for occasional subsequent epidemics, which at times have reached considerable proportions. Carriers do not necessarily spread disease.

The experiences with the summer diarrheas in Boston would suggest that there may be a somewhat similar epidemic tendency, a tendency for certain organisms to be dominant at one or another year. It was stated, for example, that in 1910 the dysentery bacillus was by far the most frequent organism found in severe diarrheas of children. In 1911 but few dysentery cases were found and the streptococcus became dominant. In 1912 neither dysentery bacilli nor the streptococcus were prominent, but the gas bacillus appeared to be the more important factor. And in 1913 dysentery, streptococcus, and gas bacillus cases were few in number and sporadic, while the capsulated bacillus appeared to be the most common etiological factor in the diarrheas.

There is one other feature of this epidemic tendency which deserves mention. It has been observed that late in the summer the type of organism met with in the diarrheas shifts somewhat, and the observations of four years' duration would suggest that the organism which will be dominant the next summer may, and not infrequently does, anticipate, as it were, the fall before, appearing somewhat abruptly in considerable numbers in atypical diarrheal cases as the season closes.

It is a well-recognized principle of epidemiology that the same organism does not produce acute disease year after year—experience has shown rather that epidemics are relatively short-lived, and that inter-epidemic periods are characterized as a rule by sporadic cases. The same explanation suggests itself in connection with the sequence of bacteria which appear to be causative agents in severe summer diarrheas. Although these diarrheas are of seasonal occurrence, the organisms associated with them do not reappear individually in epidemic proportions each year, but rather give way to other bacteria. It is impossible to predict the interval which will elapse between successive outbreaks of the same organism; the environmental conditions which may play a part in determining these outbreaks are also unknown. The reservoir from which these bacteria arise during epidemic years, and to which they may return to gather a fresh impetus as the outbreak subsides, is unknown. and the conditions which arouse these bacteria to activity are also unknown. Similarly, lobar pneumonia may be so prevalent at one or another year as to be regarded, and justly so, as epidemic; no one doubts the etiological importance of the pneumococcus in lobar pneumonia even when it is remembered that typical pneumococci are found in fully 30% of healthy throats, as "opportunists," during interepidemic years. Diphtheria bacilli are found in about 2% of healthy throats; this organism exhibits the same epidemic tendency as the pneumococcus, and strains which produce fully potent toxin may be isolated from mild sore throats, or from apparently healthy throats.

Carriers may be very important in this connection; an unexpected type of carrier has been met with in young children. Twins, aged six months, entered the Floating Hospital early in July, 1912, a year which was not a "dysentery year." These twins were not acutely ill; they were clinically mild feeding cases, and it was by accident that their movements were studied bacterially. During the eight weeks they were under observation one twin consistently harbored Shiga bacilli, the other twin Flexner bacilli. Neither gave evidence of bacterial disease. These patients would be regarded as unusually mild cases of bacillary dysentery when the facts are reviewed, and doubtless many similar cases would be discovered were careful systematic search made for them. The important point to remember is that precisely similar conditions may prevail

when any of the bacteria mentioned above "anticipate" the fall before the acute summer outbreak occurs. These atypical cases may provide a connecting link which sharply focuses the attention of the clinical and laboratory branches upon just the type of patient which in the past has led to confusion. In other words, the frank bacterial infection and the undoubted feeding case usually are recognized; the study of the doubtful and a typical case will be the most illuminating.

Whatever the final solution of the problem of the etiology of summer diarrhea may be, posterity alone can tell; the various theories will then be evaluated according to their worth, and the respect with which the present-day theories are regarded then will depend not only upon the results attained, but also upon the nature of the evidence on which these theories are based.

THE CLINICAL USE OF THE WATER MEAL IN DETERMINING THE SECRETORY AND MOTILE POWERS OF THE STOMACH.

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In an editorial in the *Journal of the American Medical Association*, No. 1, 1915, on water drinking, reference is made to the work of Carlson, Orr and Brinkman, as well as Bergeim, Reh-fuss and Hawk, on the direct influence of water in stimulating the gastric juice in the human stomach. From this we learn that water alone may induce a gastric juice whose acidity may be about 100 in less than twenty minutes after stimulation, during which time practically all of the water enters the intestine. They found that as much gastric juice was secreted, measured by its acidity, as after the Ewald test breakfast. Therefore, they claim that the water meal may be substituted for this. At the same time, when given on an empty stomach, one can demonstrate the presence of any food residue remaining from the previous day. Increased peptic power also follows the use of water.

They found that 500 c.c. of water leaves the stomach in ten to twenty minutes, and that 225 c.c. of gastric juice have been obtained from the drinking of only 50 c.c. of water. In their opinion small quantities of water produce greater stimulation than larger, and also the stimulation lasts longer. From their experiments, they consider that the acidities of 40 to 60, which are commonly accepted, are too low, and that in perfectly healthy individuals the acidities ran from 50 to 120, with an average of 77.