

tion is directly antagonized.* The thyroidase being an important factor in this process as sensitizing agent (opsonin) to facilitate the bactericidal function of the phagocytes, *thyroid gland*, 10 grains (0.6 gm.), should be given at once orally, followed by 5-grain (0.3 gm.) doses every two hours.*

The vulnerability of the cholera bacillus was shown by the researches, among others, of Pfeiffer and Vagedes,⁴³ who found that no other germ was similarly inhibited, as shown by the hanging drop. A serum employed by them (the counterpart of auto-antitoxin, as viewed from my standpoint) was diluted in fifty times its quantity of bouillon. The microscope showed the gradual inhibition of the activity of the cholera bacilli until complete inactivity of all the germs present occurred. This action is even more violent in the living serum, where the germ is not only inhibited but destroyed.

The next morbid factor to overcome is the paresis of the vascular centers, due to the direct action of the cholera endotoxin.* This is, to a certain extent, overcome by the mercury and the thyroid extract, both of which, by enhancing the functions of the adrenals, cause a general rise of the blood-pressure.* An active agent is required, however, to excite the sympathetic center, in order to cause constriction of the intestinal arterioles which are allowing the serum of the blood to escape into the intestines.* The best agent for this purpose is *morphine*, which interferes in no way with mercury and thyroid,* and also tends to relieve the suffering, which is very great.

Some theoretical objections have been raised to the use of opium, but its physiological action having remained obscure until I pointed out its action on the sympathetic center, they were devoid of foundation. Eichhorst⁴⁴ found that it gave, on the whole, the best results in the epidemic at Königsberg, and others have likewise praised it. In the light of the views submitted above, however, it should only be regarded as a valuable adjuvant, since it does not influence the protective process itself.

The curative efficiency of all these agents is greatly compromised, however, by the fact that early in the course of the disease, the blood becomes increasingly viscid until the capillary circulation is rendered practically impossible. Any amount of auto-antitoxin and any number of phagocytes which the mercury and thyroid extract may evoke become useless. Hence the overwhelming importance of *saline solution* in this disease. The great error made usually, however, is to wait until the algid

* Author's conclusion.

⁴³ Pfeiffer and Vagedes: Centralbl. f. Bakt., Bd. xix, S. 385, 1896.

⁴⁴ Eichhorst: Corresp. f. schweizer Aerzte, Sept. 15, 1892.

stage is reached, *i.e.*, when the fatal trend has begun. It should be given intravenously at a temperature of not less than 110° F. (43.3° C.) *from the outset*,* beginning with a few ounces at a sitting* and increasing to one or two quarts, if necessary, later on.

The use of saline solution is another feature which was emphasized many years ago. In 1831-32 O'Shaughnessy, writes R. H. Cox,⁴⁵ "proposed to combat the *collapse* stage" of cholera "by means of intravenous injections." He also gave the following analysis of the blood: "(1) A material diminution of the water of the blood of the cholera patient, the specific gravity of the serum ranging from 1041 to 1054; (2) a notable decrease of the quantity of soluble salts, amounting, as far as regards the serum, to a mean loss of one-third of those substances; (3) that the solid constituents of the crassamentum, including its salts, retained their normal proportions, wanting merely water to restore it to the normal state; and (4) that the dejections were alkaline and albuminous, and contained the water and soluble salts in which the serum of the blood was deficient." Latta, of Edinburgh, inspired by these conclusions, "was the first to practice intravenous injection in the *collapse* stage of cholera." His object, however, adds Dr. Cox, "was not to supply oxygen to the blood, but to replace the salines and water lost from it by the purging and vomiting." In some of the moribund cases even, detailed, the results might aptly be termed resuscitations. The highest authorities, Cantani, Hayem, Huchard, Dehio, Neumann and others, have urged the great value of saline solution. Hager,⁴⁶ after using it in 967 cases in Hamburg, was led to regard it as the only remedy of value during the algid stage. Heyse⁴⁷ likewise found intravenous injections alone to give good results. Gagen-Torn,⁴⁸ after using intravenous injections of saline solution in 209 cases with a mortality of only 15 per cent., concludes that "the injections should be given as early as possible; during the stage of reaction, they are of but little use."

Other remedies are capable of exciting the adrenal system during the acute stage—those enumerated under the next heading—but none can be said to fulfill the object as perfectly as mercury and thyroid gland.

Prophylaxis.—The vulnerability to Asiatic cholera depends, in the light of my views, upon the efficiency of the adrenal system.* As this may be raised by a number of drugs which, by exciting the test-organ and through it the adreno-thyroid center, increase markedly the blood's asset in auto-antitoxin, it may be said that it is within our power to immunize ourselves during an epidemic.* *Thyroid gland* is the most active adrenal stimulant of all, and adds opsonin to the blood; it is, therefore,

* Author's conclusion.

⁴⁵ R. H. Cox: China Med. Missionary Jour., June, 1897.

⁴⁶ Hager: Deut. med. Zeitung, Jan. 4, 1894.

⁴⁷ Heyse: Deut. med. Woch., Bd. xviii, S. 1074, 1892.

⁴⁸ Gagen-Torn: Med. Obosrenie, No. 3, 1896.

clearly indicated.* *Iodine* and the *iodides* are nearly as efficient;* *cocaine* is a powerful adrenal stimulant,* but the danger of the cocaine habit must not be overlooked; *belladonna* is likewise an adrenal stimulant,* but its action on vision precludes its use in sufficiently large quantities to afford protection. *Strychnine* is less effective than either of the above, though valuable for continuous use, especially with *quinine hydrochlorate**—but not in large doses as to the latter, since the leucocytes must not be endangered.

Alcohol, which deoxidizes the blood, and heavy smoking (nicotine being a powerful adrenal depressant) should be avoided during a cholera epidemic,* but *coffee* is beneficial, being, like strychnine and adrenal extract, a vasomotor stimulant.*

CHOLERA MORBUS.

SYNONYMS—*Cholera Nostras*; *Sporadic Cholera*.

Definition.—Cholera nostras, a sporadic non-infectious disease resembling greatly Asiatic cholera, though seldom fatal, is due to marked depression of the adrenal vasomotor and sympathetic centers by certain poisons derived from decomposing foods, shell-fish, etc., and the toxins or endotoxins of certain bacteria, some of which present the characteristics of Koch's comma bacillus.**

Symptoms.—The attack usually comes on suddenly, the earliest symptoms being, as a rule, slight faintness, fleeting griping abdominal pain and nausea. These symptoms gradually grow more intense, and are finally replaced by severe cramps in the abdomen, and sometimes in the extremities, with purging and vomiting, and marked tendency to fainting. The body and particularly the face become very cold and covered with cold sweat, and the surface temperature may be reduced several degrees. There is extreme pallor, and sometimes cyanosis, the eyes being sunken and dull. The pulse becomes rapid and weak, and in severe cases may be irregular. The patient experiences a sensation of extreme illness and prostration; his sufferings are indeed very acute.

At first the vomited material is composed of what aliments may have remained in the stomach, but soon it becomes viscid

* Author's conclusion.
** Author's definition.

and bile-like, then clear and serous. The stools also at first contain normal, though dilute, excrementitious products, but they finally become watery and may, in severe cases, present all the characteristics of the rice-water discharges of Asiatic cholera. The urine is usually scanty and may even be absent, though the patient suffers from intense thirst. This is aggravated by the fact that the salivary secretion is likewise reduced.

In the majority of cases witnessed, these symptoms last from twelve to twenty-four hours, then gradually subside, leaving the patient weak and pale for a few days. It seldom proves fatal, except in very young, old, or debilitated subjects.

The choleraic diarrhœa observed in Europe and Asia includes all the above phenomena, but they come on slowly and persist several days or even weeks, collapse occurring in some instances in from four to six days. An attack of cholera morbus may be unattended by pain, as shown by a severe case reported by G. G. Speer.⁴⁹

Pathogenesis and Pathology.—Cholera morbus is usually caused by poisons, bacterial toxins or endotoxins, including that of the comma bacillus, ptomaines or leucomains, which are ingested with beverages or decomposed foods, especially shell-fish and cheese, etc., and which the gastro-intestinal secretions and the digestive leucocytes fail to convert into benign assimilable end-products. Once in the blood they depress markedly the functions of the test-organ, *i.e.*, of the adrenal system, and those of the vasomotor and sympathetic centers.* As a result there is general relaxation of the vessels throughout the body and retrocession and accumulation of the blood in the deeper arteries, especially those of the great splanchnic area. The arterioles being simultaneously relaxed through the paresis of the sympathetic center, the glandular elements of the skin and of the alimentary canal are flooded with blood-serum, the source of the fluids which constitute their secretions.* Hence the profuse sweating, vomiting, purging and the copious serous discharge.*

At first there is considerable irritation of the gastro-intestinal mucosa. The intestinal hyperæmia witnessed, however, is not due to this enteritis, as text-books teach, but to relaxation of the vascular elements. Rubino⁵⁰ states that "the essential pathological conditions involved are a morbidly sensitive condition of the mucous membrane of the alimentary canal, a general impairment of the tonicity of tissues

* Author's conclusion.

⁴⁹ G. G. Speer: Amer. Medicine, Oct. 25, 1902.

⁵⁰ Rubino: Sajous's "Analyt. Cyclo. of Pract. Med.," vol. ii, p. 242, 1898.

with deficient oxygenation of the blood, and so decided an impairment of the vasomotor nervous influence over the vessels of the mucous membranes of the stomach and intestines as to allow copious exudation of the serous elements of the blood." The morbid sensitiveness to which he refers is, in the light of my views, the result of a temporary inability on the part of the sufferer's adrenal system to adequately protect him. Excessively warm weather, fatigue, cold and damp, etc., are all conditions which debilitate the organism and thus predispose it to cholera morbus if one of the pathogenic elements happens to be ingested. This does not mean, of course, that a sufficiently large quantity of poison will not prove pathogenic to a normal subject. Many such cases are witnessed.

In some cases, irrespective of any Asiatic cholera epidemic, germs very similar to Koch's comma bacillus are found in the evacuations. Cases of this kind have been reported by Finkler and Prior, and Gilbert and Girode.⁵¹ Talamon⁵² found, in fact, the typical bacillus, and held that "cholera nostras and cholera Asiatica were one and the same disease." Deaths from cases of this kind have been reported by Style,⁵³ Hobbs⁵⁴ and others.

Treatment.—*Opium* almost fulfills the rôle of a specific in this disease, owing to its stimulating action on the sympathetic center.* All the peripheral arterioles being soon restored to their normal caliber, the serous effusion ceases, and the blood-pressure being raised by the restitution of the normal resistance to the blood-stream, all the nerve-centers, general and subsidiary, receive more blood and resume their normal functions.* To obtain this effect, not less than $\frac{1}{4}$ grain (0.016 gm.) of *morphine* should be administered hypodermically in an adult. The *camphorated tincture of opium*, paregoric, two to three teaspoonfuls in a half tumblerful of water, is also very efficient. These doses should be repeated if necessary. *Atropine* has been found of special value in severe cases in $\frac{1}{120}$ -grain (0.00054 gm.) doses. It is, like morphine, a powerful stimulant of the sympathetic center,* and may be given simultaneously. *Calomel*, owing to the energy with which it stimulates the adrenal center, promptly restores the patient to his normal condition when given in $\frac{1}{10}$ -grain (0.0065 gm.) doses every hour three or four times.

Atropine was recommended by Hueppe⁵⁵ for cases in which the signs of intoxication are severe. Waugh⁵⁶ states that symptoms of cholera morbus subside promptly after a hypodermic injection of $\frac{1}{124}$ grain (0.00049 gm.) of atropine, repeated if necessary. He also found

* Author's conclusion.

⁵¹ Gilbert and Girode: *Le bull. méd.*, vol. v, p. 119, 1891.

⁵² Talamon: *La méd. moderne*, vol. iii, p. 543, 1892.

⁵³ Style: *Lancet*, Aug. 28, 1897.

⁵⁴ Hobbs: *La semaine méd.*, vol. xvii, p. 437, 1897.

⁵⁵ Hueppe: *Sajous's "Annual"*, vol. i, D., p. 25, 1891.

⁵⁶ Waugh: *Medical Council*, Aug., 1903.

$\frac{1}{20}$ grain (0.0033 gm.) of calomel every fifteen minutes very efficient. Most authors recommend hot aromatics, ginger, capsicum, etc. Others mention nitroglycerin among the agents tried—in vain, of course. That all drugs capable of still further increasing the vasodilation should be avoided is self-evident.

In severe cases the great loss of fluids causes the blood to become viscid, and to lose much of its plasmatic saline constituents; its osmotic properties are therefore greatly impaired, and life is endangered. Intravenous injections of *saline solution* act promptly under these conditions; three to four pints—each pint containing one teaspoonful of common salt—may be injected at a sitting.

A number of cases have been reported in which this measure actually saved life. In a case reported by John Callan⁵⁷ all the standard remedies, including morphine and belladonna, had been tried in vain. When the patient had about become pulseless and his temperature had fallen to 95.5° F. (35.3° C.), three pints of saline solution at 106° F. (41.1° C.) were injected into the median cephalic vein. Consciousness returned before the third pint had been used, and the pulse was soon beating normally.

CHOLERA INFANTUM.

SYNONYMS.—*Infantile Cholera; Acute Catarrhal Enteritis.*

Definition.—Cholera infantum, a comparatively rare form of infantile diarrhoea which symptomatically closely resembles Asiatic cholera, is due to paresis of the adrenal, vasomotor, and sympathetic centers by various kinds of poisons, especially those ingested with or formed in milk. It is usually met with in hand-fed infants.*

Symptoms.—After a period of restlessness and perhaps a slight diarrhoea with some abdominal pain, the child begins to vomit and purge with steadily increasing frequency. The temperature rises, but in the rectum only, where it may ultimately reach 105° F. (40.5° C.), the skin being cold and clammy—a condition recalling the algid stage of Asiatic cholera. The pulse is weak and rapid; the respiration is irregular or of the Cheyne-Stokes type. The infant fairly fades away, its weight and strength decreasing rapidly and its fontanelles becoming deeply depressed. It is at first very pale, then grayish, the eyes being sunken and encircled with black rings. Restlessness is marked, a fact due to abdominal and muscular cramps, the abdomen

* Author's definition.

⁵⁷ John Callan: *New Orleans Med. and Surg. Jour.*, Jan., 1896.

being retracted and the limbs in some cases being drawn up suddenly, then violently extended. Convulsions may occur, the head being retracted. Thirst is extreme—a symptom aggravated in some cases by the fact that all foods and liquids are vomited. The urine is scanty and sometimes suppressed. In some cases there is marked apathy, and the patient lies in a semi-comatose condition; the pupils are unequal and sluggish. The material vomited is at first composed of bile-stained mucus, but it soon becomes serous; the first stools are usually faecal, then perhaps greenish, but finally they also become serous and exceedingly copious and exhausting.

Collapse may occur in from a few hours to a couple of days. The decline is marked by gradual cessation of the acute symptoms and lowering of the temperature. As the end is approaching, however, the latter may become very high—107° to 108° F. (41.6° to 42.2° C.)—and convulsions may supervene, the child then lapsing into lethal coma.

Although the mortality of cholera infantum is very large, the prognosis is not altogether hopeless. The tide may turn during the first twenty-four hours, all the symptoms gradually disappearing. Relapses are not uncommon, however, and convalescence is slow.

Pathogenesis and Pathology.—Cholera infantum is due to intoxication by various kinds of poisons, bacterial toxins and endotoxins, ptomaines, leucomains, tyrotoxin, etc., ingested with, or derived from, food-stuffs. It is usually met with in hand-fed infants, and when observed in nurslings, is the result of a toxic condition of the milk due to indisposition of the nurse. The majority of cases occur during hot weather, when foods, including milk, are most apt to undergo putrefactive changes leading to the formation of poisons, or to become contaminated by dust, bacteria, flies, etc. The gastro-intestinal juices of infants being deficient in auto-antitoxin*—since the mother's milk is normally aseptic and provides her nursling with the auto-antitoxin its intestines and body require*—the intestinal poisons are absorbed.

Once in the blood, the poisons provoke, as in cholera morbus of adults, paresis of the test-organ and of the vasomotor and sympathetic centers.*

* Author's conclusion.

General vasodilation being thus produced, the blood recedes from the surface to the great central vessels, the cutaneous capillaries being practically depleted.* Hence the high rectal temperature and the simultaneous coolness of the surface, which later assumes the alidity of the corresponding period of Asiatic cholera.* This symptom is aggravated by the lowered oxygenation which the paresis of the adrenal center entails.*

The gastro-intestinal flux, the most striking symptom of the disease, is due to the paresis of the sympathetic center, *i.e.*, to the resulting dilation of the arterioles they govern.* The gastro-intestinal capillaries being engorged, the blood-serum escapes in large quantities through the mucosa and is voided as soon as a sufficient amount has accumulated in the stomach or intestine. Hence the serous character of the stools.

The terminal convulsions are due to the accumulation of waste-products in the blood, owing to the lowered oxygenation.* It denotes resumption of the adrenal functions, to such a degree sometimes, that the excessive temperature referred to, 105° to 108° F. (40.5° to 42.2° C.), is brought about.* This would prove a life-saving reaction were it not for another pathological condition, *viz.*, the viscid condition of the blood caused by the loss of serum and of the salts it contains. Its osmotic properties being greatly impaired, it can no longer penetrate the capillary walls to bathe the cellular elements and sustain life.*

Many pediatricists and bacteriologists have closely studied the bacteriology of cholera infantum, but the consensus of opinion at the present time is that it cannot be attributed to a specific bacterium. That various microorganisms may, either through their toxins or the decomposition they promote in the ingesta and other factors enumerated in the text, cause the disease, is generally recognized. As stated by Blackader,⁵⁸ "there are very few changes found after death either in the intestinal canal or in any of the organs"—a fact which, in view of the violence of the symptoms, relegates us to the nervous system. Indeed, the same author says in this connection: "The earlier symptoms may, therefore, reasonably be ascribed to the influence of some toxin upon the heart, nerve-centers and vasomotor nerves of the intestines, while many of the later symptoms must be referred to the great abstraction of serous fluid from the body." While this explains nothing, it points to the nervous system as an initial factor in the morbid process. Again, Tyson⁵⁹ writes: "The temperature should be taken in the rectum, as that of the axilla may be misleading. Indeed, the skin sometimes feels cool when the internal temperature is high." In the light of my views the axillary temperature does not mislead: it points to the actual con-

* Author's conclusion.

⁵⁸ Blackader: Sajous's "Analyt. Cyclo. of Pract. Med.," vol. ii, p. 235, 1898.

⁵⁹ Tyson: *Loc. cit.*, third edition, p. 390, 1903.

dition—a low peripheral temperature, while that of the rectum is high. As I have explained, this is due to paresis of the vasomotor center.

Treatment.—The measures indicated in this disease depend upon the progress it has made when the infant is first seen. Powerful adrenal stimulants are required when the case is seen early; if seen late, the first indication is to restore the blood to its normal fluidity, and then to use adrenal stimulants.*

If the child is seen before the rice-water stools and algidity have begun, and the stools are still fecal or greenish and acid, *calomel* is required, $\frac{1}{4}$ grain (0.016 gm.) being administered every twenty minutes until the stools assume a better aspect—which they usually do after five or six doses have been taken. This agent not only rids the intestines of toxic substances, but it stimulates powerfully the adrenal center. By thus causing an accumulation of auto-antitoxin in the blood, it promotes catabolism of the poison, especially in the liver. Moreover, a cardinal feature of the curative process is the fact that the increase of auto-antitoxin raises the tone of the vessels and the general blood-pressure by penetrating the muscular layer of the vessels. Calomel is endowed, therefore, with all the attributes of a curative agent, provided it is used with adequate energy.*

Referring to the great mortality of cholera infantum as given by most competent authorities, Rotch, Holt and Jacobi, viz., two-thirds of all cases treated, W. H. Wallace⁶⁰ states that, inspired by my views as given in the first volume⁶¹ in respect to this disease, he had resorted to active stimulation which included calomel, $\frac{1}{4}$ grain (0.016 gm.), every half-hour until signs of bile appeared in the stools, and had been able to save his two last cases. Stengel⁶² gives $\frac{1}{8}$ grain (0.008 gm.) every four hours, but I do not consider this dose adequate. Taylor and Wells⁶³ recommend $\frac{1}{40}$ to $\frac{1}{30}$ grain (0.0016 to 0.002 gm.) every fifteen minutes until two or three grains (0.13 or 0.2 gm.) have been administered.

Contrary to what is taught in text-books, the so-called "hyperpyrexia" should *not* be combated.* The high temperature being central only and due to the accumulation of blood in the deeper vessels, especially the splanchnic area, every effort should be made to restore the equilibrium of the circulation by measures which promote cutaneous hyperæmia:* by rubbing with warm flannel; warm baths—beginning with 98.6° F. (37° C.), the normal temperature, and raising it gradually to 105° F.

* Author's conclusion.

⁶⁰ Wallace: Va. Med. Semi-monthly, July 22, 1904.

⁶¹ Cf. vol. i, pp. 47 and 773 in the first two editions.

⁶² Stengel: No. Carolina Med. Jour., Apr. 20, 1899.

⁶³ Taylor and Wells: "Dis. of Children," p. 205, 1899.

(41.2° C.); hot-water bottles, etc., the very measures indicated in the corresponding stage of Asiatic cholera.

Although various authors compare the frigidity of the surface in cholera infantum to the algid stage of cholera, they recommend cold baths in the former and hot bottles in the latter. Cold baths might prove of service by promoting the formation of waste-products and, through these, stimulation of the adrenal center; but the paucity of blood in the skin to which the frigidity is due defeats this action and annuls the value of the remedy. Roeder⁶⁴ recommends a warm mustard bath, followed by rubbing and placing of the child in a warm bed, "every effort being made to sustain the body warmth."

As soon as the intestines are satisfactorily cleared by the calomel, flushing of the colon is indicated, using lukewarm *normal saline solution*, one pint (500 gm.). Simultaneously a small quantity of the solution, $2\frac{1}{2}$ drachms (10 gm.), should be injected hypodermically—repeatedly in severe cases. The sensitiveness of the skin being reduced, owing to the deficiency of blood, the child hardly feels the prick of the needle. When dehydration by copious and repeated serous stools is present, large quantities, 6 to 8 ounces (180 to 250 gm.), should be injected subcutaneously.

As stated by Stengel,⁶⁵ flushing of the colon and tepid baths will cause the symptoms to abate. Epstein⁶⁶ observed prompt improvement and rapid recovery in apparently hopeless cases by means of small doses of saline solution injected subcutaneously. Loin⁶⁷ injected 14 drachms (56 gm.) night and morning in infants from three weeks to six months old, and found it effective after every other measure had failed. Many other reports of this kind are available. Blackader⁶⁸ states that 8 ounces (236 gm.) or more, injected at once into the subcutaneous tissues of the thigh, abdomen or buttock, repeated twice daily if necessary, usually causes marked improvement of all symptoms.

When the case is seen after the serous stools have started, agents which stimulate the sympathetic center are necessary in addition to the foregoing measures, to reduce the caliber of the arterioles which this system governs.* *Morphine* is an active agent of this kind (especially after the osmotic properties of the blood have been restored by the use of saline solution in small or large doses) when given hypodermically in $\frac{1}{100}$ -grain (0.00065 gm.) doses for a one-year-old child. Or, one or more drops of the *tincture of opium* may be given in an enema, ac-

* Author's conclusion.

⁶⁴ Roeder: Die Therapie der Gegenwart, June, 1904.

⁶⁵ Stengel: *Loc. cit.*

⁶⁶ Epstein: Cited by H. F. Thompson: Med. News, Apr. 25, 1903.

⁶⁷ Loin: Semaine méd.; Brit. Med. Jour., Nov. 20, 1897.

⁶⁸ Blackader: Sajous's "Analyt. Cyclo. of Pract. Med.," vol. ii, p. 238, 1898.

according to age. *Atropine* is another valuable agent of this kind, and is, on the whole, safer for infants, $\frac{1}{500}$ grain to $\frac{1}{250}$ grain (0.00013 gm. to 0.00026 gm.), according to age, being well borne subcutaneously. By augmenting the propelling power of the arterioles, it drives blood into the peripheral capillaries, thus counteracting the hypothermia.*

As emphasized by Potter,⁶⁹ opium should never be given when the discharges are green, slimy or offensive. Jacobi⁷⁰ recommends the warm enemata containing some alcohol and one or more drops of laudanum. The use of atropine has been recommended by many reliable observers. Sterrett⁷¹ states that under the influence of $\frac{1}{250}$ grain (0.00026 gm.) in water, one such granule being given for each year of the child's age, every fifteen or thirty minutes, "the vomiting usually ceases, the skin becomes warm and the circulation equalized." Carefully dosed granules, such as those of the Abbott Company, should be used, to avoid untoward effects.

INFANTILE DIARRHOEA.

SYNONYMS.—*Summer Diarrhœa; Acute Gastro-enteritis; Dyspeptic Diarrhœa.*

Definition.—Infantile diarrhœa—a disease caused in most instances by the substitution of artificial foods for breast milk, which, owing to the auto-antitoxin it contains, protects the nursing against infection—is due to excessive irritation of the intestinal mucosa by toxic substances, especially the toxins of bacteria ingested with cow's milk.**

Symptoms.—These vary according to the location of the inflammatory process. If the small intestine is involved alone, the symptoms of *acute dyspeptic enteritis* prevail. The first of these, in the majority of cases, are restlessness, peevishness, and a slight fever, attended perhaps with slight colic, looseness of the bowels and nausea. These phenomena gradually become more severe until vomiting and purging occur. The stools, which at first may have contained undigested food detritus, are now and then offensive, green or greenish-yellow or brown. The temperature rises, reaching sometimes 104° F. (40° C.), the pulse being rapid and feeble. As the stools become more frequent, emaciation progresses rapidly, the child's aspect changing greatly within a few days. In some cases the onset is more

* Author's conclusion.

** Author's definition.

⁶⁹ Potter: *Annals of Gynec. and Ped.*, Apr., 1898.

⁷⁰ Jacobi: *Pediatrics*, July 1, 1896.

⁷¹ Sterrett: *Annals of Gynec. and Ped.*, Aug., 1904.

sudden, all the symptoms enumerated coming on in rapid succession from the first, including the high fever, but excepting the purging. As the latter appears the temperature may recede one or more degrees. In this class of cases nervous phenomena are apt to prevail, *i.e.*, marked restlessness, delirium and even convulsions. Prostration increases as the disease progresses until slight cyanosis, coldness of the extremities and rapid diminution of the child's suffering indicate impending death.

When the inflammatory process is located chiefly in the ileum and colon, constituting *acute entero-colitis*, the earliest symptoms are, as a rule, similar to those of the preceding condition, but they come on abruptly and are supplemented by others which point directly to the large intestine as their source. Thus, while early vomiting is marked when the small intestine is alone involved, it is much less severe when the lesions are mainly located in the colon; the abdomen is apt to be tense, swollen and tender along the course of the colon. Various symptoms that recall dysentery also appear, *i.e.*, considerable mucus and more or less blood in the stools, straining, pain and sometimes intestinal prolapse during defecation. The stools are not copious as in dyspeptic enteritis, but small, and, as a rule, quite green, though sometimes brown. In rare cases shreds of pseudo-membrane are also passed. The prostration and nervous phenomena observed in dyspeptic enteritis may also occur, but ulceration of Peyer's patches and other intestinal glands causes these cases often to assume a typhoid type. Wasting progresses rapidly and the infant is almost reduced to a skeleton when, as usually happens, the case lasts five or six weeks.

The chances of recovery depend greatly upon the environment of the infant and its condition. Among the well-to-do the prognosis is far more favorable than among the poor, owing to the unsanitary surroundings of the latter, and also to the fact that their children are often puny and ill-fed.

Pathogenesis and Pathology.—The one great cause of infantile diarrhœa, of the millions of lives it has cost, and of the thousands of infants it is killing each year, is *the substitution of artificial foods of any kind*, including cow's milk supposedly adjusted to the physiological needs of the human organism, *for Nature's own food, the mother's milk, or failing it, breast-milk.*

Telling in this connection are the following lines by no less an authority than Jacobi:⁷² "Amongst those who believe in the omnipotence of chemical formulæ, there prevails the opinion that a baby deprived of mother's milk may just as readily be brought up on cow's milk; that is easily disproved. In Berlin they found amongst the cows'-milk-fed babies under a year, the mortality was six times as great as amongst breast-fed infants. Our own great cities gave us similar, or slightly smaller, proportions, until the excessive mortality of the very young was somewhat reduced by the care bestowed on the milk introduced into both our palaces and tenements. Milk was examined for bacteria, cleanliness and chemical reaction. It was sterilized, pasteurized, modified, cooled, but no cow's milk was ever under the laws of Nature changed into human milk, and with better milk than the city of New York ever had, its infant mortality was greater this summer [1904] than it has been in many years. That hundreds of thousands of the newly-born and small infants perish every year on account of the absence of their natural food, is a fact which is known and which should not exist."

The statistics of the question point overwhelmingly in the same direction. Emmett Holt found that of 1943 fatal cases of digestive disorders, only 3 per cent. had been breast-fed. In a series of 718 fatal cases of infantile diarrhœa in Liverpool, studied by Jones,⁷³ the proportion of breast-fed infants was nearly as low, i.e., 4.2 per cent. He states that in Munich the general mortality among breast-fed infants is 15 per cent., while in artificially-fed infants it is 85 per cent. J. Lewis Smith says that at Lyons, where foundlings (a class of infants, the parents of which are often alcoholics, syphilitics, etc.) are wet-nursed, the mortality is 337 per thousand, whereas at Aix, also a provincial city, where they are fed artificially, it is 80 per cent. In New York it reached nearly 100 per cent. until wet-nurses were provided. Winters⁷⁴ states that "during the siege of Paris (1870-71), while the general mortality was doubled, that of infants was lowered 40 per cent. owing to mothers being driven to suckle their infants!" "In my own experience," writes Holt, "fatal cases of diarrhœal diseases in nursing infants are extremely rare."

The enormous mortality in artificially-fed infants is due to the fact that none of the artificial foods, including cow's milk, even when obtained under the most favorable conditions and accurately adjusted as to proteids, carbohydrates, inorganic salts, etc., to the composition of human milk, supply the infant with bactericidal and antitoxic constituents that breast-milk contains, i.e., the lacteal auto-antitoxin.* This immunizing substance serves not only to prevent infection of the infant's alimentary canal, but it penetrates into its blood to afford protection against infections of all kinds.*

Ehrlich⁷⁵ showed that milk was rich in antitoxin, though less so than blood, as he subsequently found with Wassermann.⁷⁶ As stated by

* Author's conclusion.

⁷² Jacobi: Amer. Medicine, Nov. 5, 1904.

⁷³ Jones: Brit. Med. Jour., Sept. 29, 1894.

⁷⁴ Winters: Med. Record, Mar. 7, 1903.

⁷⁵ Ehrlich: Zeit. f. Hyg., Bd. xii, S. 183, 1892.

⁷⁶ Wassermann: *Ibid.*, Bd. xviii, S. 248, 1894.

Metchnikoff, "the chemical composition of antitoxin is unknown." That the milk's antitoxin is similar to that in the blood, i.e. of auto-antitoxin, is demonstrated by the presence of the three constituents of the latter. The presence of *adrenoxidase* is shown by the fact that Babcock and Russell,⁷⁷ Dupouy,⁷⁸ Raudnitz,⁷⁹ Arnold,⁸⁰ Neumann Wender⁸¹ and others have all found an oxidase in milk which colored guaiac blue. The last-named investigator also found that milk contained a proteolytic enzyme which he refers to as *trypsin* or galactase. Spolverini⁸² found both trypsin and pepsin, and his observation was confirmed by Nobécourt and Merklen⁸³ and others. We have seen that the *nucleo-proteid* was also present as a constituent of fibrinogen. There can be no doubt as to the immunizing agencies being the same as in the blood. Van de Velde and Landstheer⁸⁴ found that all the milk ferments were also present in the blood.

The bacteriolytic property of the blood, according to the Buchner school, is due to alexins which, as I have shown in the first volume, are similar in composition to antitoxin. E. Moro⁸⁵ found that the serum of breast-fed infants not only contained more alexins than artificially-fed ones, but that the proportion corresponded with that of the alexins in the blood of the maternal placenta. This indicates that it is the function of the mother's milk to supply the infant's blood with antitoxin, precisely as her blood did her fetus in utero. This was emphasized by the investigations of Halban and Landsteiner,⁸⁶ which showed that the maternal blood was, as compared to that of the fetus, more potent as a bacteriolytic and antitoxic agent and as an immunizing serum; and moreover, that it inhibited more actively fermentative processes. Metchnikoff⁸⁷ states that the passage of the antitoxin ingested with milk into the suckling's blood, has been confirmed by a large number of observations. Welch, in his Harvey Lecture, also says: "It is an important function of the mother to transfer to the suckling through her milk immunizing bodies, and the infant's stomach has the capacity, which is afterward lost, of absorbing these substances in an active state. The relative richness of the suckling's blood in protective anti-bodies, as contrasted with the artificially-fed infant, explains the greater freedom of the former from infectious diseases."

Although cow's milk is likewise rich in auto-antitoxin, the latter begins to lose its activity soon after milking, because its nucleo-proteid combines with the *adrenoxidase*, thus depriving the immunizing compound of its two activating agents.* The fluid portion of the milk thus becomes reduced to the condition of blood-serum, an excellent culture medium for bacteria. Hence the fact that in a few hours, especially during warm weather, milk is often found to contain enormous quantities of

* Author's conclusion.

⁷⁷ Babcock and Russell: Annual Report of Agric. Sta., Univ. of Wisc., 1897.

⁷⁸ Dupouy: Thèse de Bordeaux, 1897.

⁷⁹ Raudnitz: Zentralbl. f. Physiol., Bd. xii, S. 790, 1898.

⁸⁰ Arnold: Arch. f. Pharm., Nu. 41, 1881.

⁸¹ Neumann Wender: *CEsters. Chem. Zeit.*, 1902.

⁸² Spolverini: Atti d. iv. Congr. Ital. de Ped., 1901.

⁸³ Nobécourt and Merklen: La presse méd., Dec. 24, 1902.

⁸⁴ Van de Velde and Landstheer: Arch. de méd. des enfants, vol. vi, p. 408, 1903.

⁸⁵ E. Moro: Jahrb. f. Kinderheilk., Apr., 1902.

⁸⁶ Halban and Landsteiner: Amer. Jour. Med. Sci., May, 1903.

⁸⁷ Metchnikoff: *Of.* vol. i, p. 371.