dered animals immune against the cholera virus, but it is not probable that the method which they employ would be available for man.

Medicinal Treatment.—During the initial stage, when the diarrhœa is not excessive but the abdominal pain is marked, opium is the most efficient remedy, and it should be given hypodermically as morphia. It is advisable to give at once a full dose, which may be repeated on the return of the pain. It is best not to attempt to give remedies by the mouth, as they disturb the stomach. Ice should be given, and brandy or hot coffee. In the collapse stage, writers speak strongly against the use of opium. Undoubtedly it must be given with caution, but, judging from its effects in cholera nostras, I should say that collapse *per se* was not a contra-indication. For the intense thirst the patient may be given ice-water, of which he should be allowed to drink freely. The vomiting is very difficult to check. In severe cases creosote, hydrocyanic acid, and other remedies seem quite ineffectual.

Salol has been warmly recommended as capable of preventing the development of the bacilli in the intestine.

External applications of heat should be made and a hot bath may be tried. Warm applications to the abdomen are very grateful. Hypodermic injections of ether will be found serviceable.

Judging from the success which has followed the copious enemata in *cholera infantum*, this practice should be tried. Two or three pints of water should be allowed to flow slowly into the rectum. If the hips are elevated it may be retained for some time, but is usually rapidly ejected. The water may be given either cold or warm; probably the latter would be better. During the last epidemic in Italy, Cantani used this method, which he calls *enteroclysis*, with great success. In each injection he gave tannic acid and, generally, laudanum.

Owing to the profuse serous discharges the blood becomes concentrated, and absorption takes place rapidly from the lymph-spaces. This it is which gives the shrunken puckered appearance to the features and skin of a patient in the collapse stage. To meet this, intravenous injections have been practised. My preceptor, Bovell, first practised the intravenous injections of milk in Toronto, in the epidemic of 1854. Less risky and equally efficacious is the subcutaneous injection of a saline solution. For this common salt should be used in the proportion of about four grammes to the litre. With rubber tubing, a canula from an aspirator, or even with a hypodermic needle, the warm solution may be allowed to run by pressure beneath the skin. It is rapidly absorbed, and the process may be continued until the pulse shows some sign of improvement. This is really a valuable method, thoroughly physiological, and should be tried in all severe cases.

In the stage of reaction special pains should be taken to regulate the diet and to guard against recurrences of the severe diarrhœa.

XIX. YELLOW FEVER.

Definition.—An acute febrile disease of tropical and subtropical countries, characterized by jaundice and hæmorrhages, and due to the action of a specific virus, the nature of which is yet unknown.

Etiology.—The disease prevails endemically in the West Indies and in certain sections of the Spanish Main. From these regions it occasionally extends and, under suitable conditions, prevails epidemically in the Southern States. Now and then it is brought to the large seaports of the Atlantic coast. Formerly it occurred extensively in the United States. In the latter part of the last century and the beginning of this, frightful epidemics prevailed in Philadelphia and other Northern cities. The epidemic of 1793, so graphically described by Matthew Carey, was the most serious that has ever prevailed in any city of the Middle States. The mortality, as given by Carey, during the months of August, September, October, and November, was 4,041, of whom 3,435 died in the months of September and October. The population of the city at the time was only 40,000. Epidemics occurred in the United States in 1797, 1798, 1799, and in 1802, when the disease prevailed slightly in Boston and extensively in Baltimore. In 1803 and 1805 it again appeared; then for many years the outbreaks were slight and localized. In 1853 the disease raged throughout the Southern States. In New Orleans alone there was a mortality of nearly eight thousand. In 1867 and 1873 there were moderately severe epidemics. In 1878 the last extensive epidemic occurred, chiefly in Louisiana, Alabama, and Mississippi. The total mortality was nearly sixteen thousand. In Europe it has occasionally gained a foothold, but there have been no wide-spread epidemics except in the Spanish ports. The disease exists on the west coast of Africa. It is sometimes carried to ports in Great Britain and France, but it has never extended into those countries. The history of the disease and its general symptomatology are exhaustively treated in the classical work of Réné La Roche.

Guitéras recognizes three areas of infection: (1) The focal zone in which the disease is never absent, including Havana, Vera Cruz, Rio, and other Spanish-American ports. (2) Perifocal zone or regions of periodic epidemics, including the ports of the tropical Atlantic in America and Africa. (3) The zone of accidental epidemics, between the parallels of 45° north and 35° south latitude.

The epidemics are invariably due to the introduction of the poison either by patients affected with the disease or through infected articles. Unquestionably the poison may be conveyed by fomites. Individuals of all ages and races are attacked. The negro is much less susceptible than the white, but he does not enjoy an immunity. Residents in southern countries, in which the disease is prevalent, are not so susceptible as strangers and temporary residents. Males are more frequently affected and the mortality is greater among them, owing probably to greater exposure.

Very young children usually escape; but in the epidemics of large cities the number under five attacked is large, since they constitute a considerable proportion of the population unprotected by previous attack. Guitéras states that the "foci of endemicity of yellow fever are essentially maintained by the creole infant population." Immunity is acquired by passing through an attack or by prolonged residence in a locality in which it is endemic. The statement so often made that the creoles are exempt from yellow fever has been abundantly disproved. They certainly are not so susceptible, but in severe epidemics they die in numbers. The evidence in favor of inherited immunity is not conclusive.

Conditions favoring the Development of Epidemics.—Yellow fever is a disease of the sea-coast, and rarely prevails in regions with an elevation above one thousand feet. Its ravages are most serious in cities, particularly when the sanitary conditions are unfavorable. It is always most severe in the badly drained, unhealthy portions of a city, where the population is crowded together in ill-ventilated, badly drained houses. The disease prevails during the hot season. In Havana the death-rate is greatest during the months of June, July, and August. The epidemics in the United States have always been in the summer and autumn months.

The specific germ of the disease has not yet been discovered. Sternberg, in his last report to the United States Government, concludes that the specific cause of yellow fever has not yet been demonstrated. With this statement Cornil and Babes * agree, and they do not accept the organisms described by Fréire, Carmona, and Gibier.

Morbid Anatomy.—The skin is more or less jaundiced. Cutaneous hæmorrhages may be present. No specific or distinctive internal lesions have been found. The blood-serum contains hæmoglobin, owing to destruction of the red cells, just as in pernicious malaria. The heart sometimes, not invariably, shows fatty change; the stomach presents more or less hyperæmia of the mucosa with catarrhal swelling. It contains the material which, ejected during life, is known as the *black vomit*. The essential ingredient in this is transformed blood-pigment. In the two specimens which I have had an opportunity of examining it differed in no respect from the material found in other affections associated with hæmatemesis. There is no proof that this black material depends upon the growth of a micro-organism. The liver is usually of a pale yellow or brownish-yellow color, and the cells are in various stages of fatty degeneration. From the date of Louis's observations at Gibraltar in 1828, the appearances of this organ have been very carefully studied, and some have thought the changes in it to be characteristic. Councilman has described remarkable appearances in the liver-cells which he believes are distinctive and peculiar. Fatty degeneration and regions of necrosis are present in all cases. The kidneys often show traces of diffuse nephritis. The epithelium of the convoluted tubules is swollen and very granular; there may also be necrotic changes. In both liver and kidneys bacteria of various sorts have been described.

* Les Bactéries, 1890.

Symptoms.—The incubation is usually three or four days, but it may be less than twenty-four hours and prolonged to seven days. The onset is sudden; as a rule, without preliminary symptoms. An initial chill is common, and with it are usually associated headache and pains in the back and limbs. The fever rises rapidly and the skin feels very hot and dry. The face is flushed; the tongue furred, but moist; the throat sore. Nausea and vomiting are present, and become more intense on the second or third day. The bowels are usually constipated. The urine is reduced in amount and may be albuminous from the outset. The pulse, at first, has the usual febrile characters, but quickly becomes feeble and, as the jaundice develops, may become slow. This stage of invasion, or the *febrile stage*, lasts from a few hours to two or three days. It is succeeded by a remission, or, as it has sometimes been called, the *stage of calm*, during which the temperature falls and the severity of the symptoms abates. In favorable cases the fever now subsides and convalescence sets in. In such cases jaundice may not develop. In the third stage, or that of the *febrile reaction*, the temperature rises again and the symptoms become aggravated. The jaundice develops rapidly, the vomiting increases, and, in a considerable proportion of the cases, black vomit occurs. This consists of blood and gastric mucus altered by the acid juices of the stomach. Though usually regarded as distinctive and characteristic of the disease, material identical with it is brought up under other febrile conditions in which vomiting of blood occurs. Altered blood-corpuscles, epithelial cells, portions of food, and various fungi are found in the fluid. The vomiting may be accompanied by great abdominal pain. The stools are often tarry from the presence of altered blood. In mild cases the vomiting ceases during the first stage of the disease. Black vomit is not necessarily a fatal symptom, though it is present only in the severer cases of the disease. Jaundice occurs in a limited number of the cases which recover, and is present in almost all the fatal cases. From the character of the disease it is probably hæmatogenous in its origin. Bleeding may occur from the kidneys or from the gums, and hæmorrhages into the skin are not uncommon. As would be expected in a fever of this nature, the urine is albuminous; the amount varying a good deal with the intensity of the fever, and with the grade of jaundice. Febrile icterus, from whatever cause, is almost invariably associated with albuminuria and tube-casts, and the evidences of a diffuse nephritis.

Relapses occasionally occur. Among the varieties of the disease it is important to recognize the mild cases. These are characterized by slight fever, continuing for one or two days, and succeeded by a rapid convalescence. Such cases would not be recognized as yellow fever in the absence of a prevailing epidemic. Cases of greater severity have high fever and

the features of the disease are well marked—vomiting, prostration, and hæmorrhages. And lastly there are malignant cases in which the patient is overwhelmed by the intensity of the fever, and death takes place in two or three days.

In severe cases convalescence may be complicated by the occurrence of parotitis, abscesses in various parts of the body, and diarrhœa. An attack confers an immunity which persists, as a rule, through life.

Diagnosis.—Mild cases, and even severe cases in the early period of an epidemic, are very difficult to recognize. The disease simulates closely, and may be mistaken for ordinary malarial remittent fever. It is not uncommon for physicians, in regions in which yellow fever is occasionally epidemic, to call the milder cases malarial fever, reserving the name of yellow fever for the severer forms with jaundice and black vomit. The only disease with which these cases could be confounded is malaria in its remittent and pernicious forms. But yellow fever can now be definitely and at once separated by the examination of the blood. Twice in Philadelphia I was sent for to determine whether a patient, freshly arrived in the city from the South, had yellow fever or pernicious malaria; and I was able in both instances, by finding Lavaran's organisms in the blood, to pronounce definitely upon the nature of the disease. The clinical picture in certain cases of malarial remittent and yellow fever may be almost identical. The presence of albumen in the urine, upon which some writers lay such stress as a distinguishing feature in yellow fever, is far too common a symptom in all forms of malaria to be worth much as a guide. Guitéras states that there may be difficulty for a time in recognizing the difference between mild cases of thermic fever and yellow fever.

Prognosis.—In its graver forms, yellow fever is one of the most fatal of epidemic diseases. The mortality has ranged, in various epidemics, from 15 to 85 per cent. In heavy drinkers and those who have been exposed to hardships the death-rate is much higher than among the better classes. In the epidemic of 1878, in New Orleans, while the mortality in hospitals was over 50 per cent of the white and 21 per cent of the colored patients, in private practice the mortality was not more than 10 per cent among the white patients. Favorable symptoms are a low grade of fever, slight jaundice, absence of hæmorrhages, and a free secretion of urine. If the temperature rises above 103° or 104° during the first two days, the outlook is serious. Black vomit is not an invariably fatal symptom. Cases with suppression of urine, delirium, coma, and convulsions rarely recover.

Prophylaxis.—The measures to be taken are—

(*a*) "Exclusion of the exotic germ of the disease by the sanitary supervision, at the port of departure, of ships sailing from infected ports, and thorough disinfection at the port of arrival, when there is evidence or reasonable suspicion that they are infected; (*b*) isolation of the sick on shipboard, at quarantine stations, and, so far as practicable, in recently infected places; (*c*) disinfection of excreta, and of the clothing and bedding used by the sick, and of localities into which cases have been introduced, or which have become infected in any way; (*d*) depopulation of infected places—i. e., the removal of all susceptible persons whose presence is not necessary for the care of the sick" (Sternberg). During an epidemic, individuals who must remain in the locality should avoid the regions in which the disease prevails most; they should live temperately, avoiding all excesses, and should be careful not to get overheated, either in the sun or by exercise. It is very doubtful whether the preventive inoculations introduced by Fréire in Brazil and Carmona in Mexico are of any value.

Treatment.—Careful nursing and a symptomatic plan of treatment probably give the best results. Bleeding has long since been abandoned. How much patients will stand in this disease is illustrated by Rush's practice, which was of the most heroic character. He says: "From a newly arrived Englishman I took 144 ounces, at twelve bleedings, in six days; four were in twenty-four hours. I gave within the course of the same six days nearly 150 grains of calomel, with the usual proportions of jalap and gamboge"* With the courage of his convictions this modern Sangrado himself submitted to two bleedings in one day, and had his infant of six weeks old bled twice. Neither emetics nor purgatives are now employed. Of special remedies quinine is warmly recommended, and, when hæmorrhage sets in, the perchloride of iron. Digitalis, aconite, and jaborandi have been employed. Sternberg advises the following mixture: Bicarbonate of soda, 150 grains; bichloride of mercury, $\frac{1}{3}$ grain; pure water, 1 quart. Three tablespoonfuls to be given every hour. This is given on the view that the specific agent is in the intestine, and that its growth may possibly be restrained by this antacid and antiseptic mixture. The fever is best treated by hydrotherapy. There are several reports of the good effects of cold baths, sponging, and the application of ice-cold water to the head and the extremities in this disease. Vomiting is a very difficult symptom to control. Morphia hypodermically and ice in small quantities are probably the best remedies. Medicines given by the mouth for this purpose are said to be rarely efficacious.

We have no reliable medicine which can be depended upon to check the hæmorrhages. Ergot and acetate of lead and opium are recommended. The uræmic symptoms are best treated by the hot bath. Stimulants should be given freely during the second stage, when the heart's action becomes feeble and there is a tendency to collapse. The patient should be carefully fed; but when the vomiting is incessant it is best not to irritate the stomach, but to give nutritive enemata until the gastric irritation is allayed.

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* Manuscript letter to Redman Coxe.