poisoning from wall papers in damp, ill-ventilated rooms through the formation of arsine by fungi and bacteria.

In strictly chronic poisoning the specific action of the poison manifests itself in anæmia or pernicious anæmia.

The effects of arsine on the system appear slowly. The victim shivers, complains of chills, and often of an indescribable feeling of sickness passing into great uneasiness and fear, resulting in exhaustion, weakness, and repeated fainting fits, during which the body is cyanotic, cold, and bathed in cold sweat. There is a blackness before the eyes and the pupils are dilated. There may or may not be nausea and vomiting. The pulse is somewhat accelerated but small and weak. Respiration is dyspnœic. The breath and mouth are fetid. After eight or ten hours, or even much later, the specific effects of the poison manifest themselves; the red blood corpuscles are destroyed and methæmoglobin is formed. All the urine passed is bloody, deep red, dark brown, or even black. There is sometimes anuria. Polycholia sets in and the skin becomes icteric or dark-colored. The stools are not watery as in arsenicism, but are colored dark with bile. The liver and spleen are swollen and painful on pressure. There are severe headache and a fear of death. Death occurs from œdema of the lungs or from paralysis of the heart. If death does not result the period of convalescence is generally very long. Spectroscopic examination of the blood for bands of methæmoglobin is of great value in diagnosis. These characteristic bands will also be noted after death, providing that an examination is promptly made.

The treatment of cases of arsine poisoning is difficult and unsatisfactory. Sodium bicarbonate should be administered to convert the methæmoglobin into alkaline methæmoglobin, which the body can readily change to oxyhæmoglobin. Transfusion of blood may often be imperative. The clogging of the canals of the kidneys has been successfully treated by injection of normal salt solution. The remaining treatment must be symptomatic. In the choice of stimulants to counteract the severe depression of the heart's action it should be remembered that alcohol is barred because of its action on the kidneys.

Clinical Tests.—For the rapid detection of arsenic in the urine, vomited matter, stools, etc., where much organic matter is present, there is nothing superior to the Reinsch method, *i.e.*, acidification with pure HCl and boiling with a tiny strip of pure copper foil or gauze. The stained copper should then be tested by heating in a glass tube in contact with air and the crystalline sublimate of As_2O_3 examined with a hand lens or microscope. For inorganic material the modified Gutzeit test will be found to be rapid and reliable. The gases evolved by the action of sulphuric or hydrochloric acid on zinc in the presence of a solution of the material to be tested are passed through cotton moistened with lead acetate (to hold back any hydrogen sulphide), and are tested either with filter paper moistened with mercuric chloride or with a dry crystal of silver nitrate. In the presence of arsenic the mercuric chloride spot turns brick-red, orange, or brown; the silver nitrate crystal first canary or lemon-yellow, then black. *Emile Monnin Chamot.*

ASIATIC CHOLERA.—(Synonyms: Epidemic cholera, Cholera asphyxia, Algid cholera, Malignant cholera, Cholera spasmodica, Pestilential cholera, Pestilential asphyxia, Oriental cholera, Choleric pestilence, Indian cholera, Ganglionitis peripherica et medullaris, Trisplanchnia, Hyperanthraxis, Morbus oryzeus [because supposed by Tytler to be due to damaged rice], Troussegalant, Cholera gravior, Vishucki or Vishuchiki [by Hindoo physicians], Haouwa [tornado] in Bagdad.) (For a wider discussion of terminology, see Macpherson, "Annals of Cholera," chapter ii., ed. 1884.)

The derivation of the word cholera is usually from χολὴ ῥεῦ (flow of bile), or χολὰς ῥεῦ (intestinal flux), but the correct one is probably that given by Jobard, of Brussels (*Gaz. Méd. de Paris*, 1832, p. 389), who considers the term to be made up from two Hebrew words, choli-ra (or morbus malus).

Asiatic, or epidemic, cholera is an acute infectious disease that is endemic in certain parts of India, and that has during the last century advanced out of that country to other parts of the world, where, in its epidemic form, it has produced great loss of life. It is characterized by its great fatality among the communities to which it may be transported, by the apparent ease with which it has been carried from place to place, and by its invariably following the lines of travel in its march from one place to another. It is distinctly a disease of the gastro-intestinal tract, produced, primarily, by a micro-organism and attended with secondary symptoms, due to the absorption of toxic principles elaborated during the development of this micro-organism.

There is only a difference of degree between cholera, choleraic diarrhœa, and cholerine—the disease is the same in all these forms provided that they are accompanied by the activity of the spirillum of Koch. So far as true cholera and cholera nostras are concerned, there is a very great similarity, or rather there may be, between the clinical symptoms of the two diseases, but the differentiation may be easily made by the isolation of the specific spirillum of the former. The same thing is true in regard to the differentiation of true cholera from an attack of indigestion, which, if severe enough, may take on many of the characteristics of true cholera. Cholera nostras is a seasonal disease and is not transportable, and it has been known for ages. True cholera made its first advance out of India in 1817, and since that time has been seen periodically in Europe. In all cases it has followed the line of travel, and has never been seen to be distributed in any other way. Therefore true cholera never makes its appearance except after other cases have been seen that might excite suspicion, while cholera nostras appears only in hot weather, in sporadic cases, and dies out if the weather becomes cooler.

The period of cyanotic chills, although one of the most striking in both diseases, gives no special indications for differential diagnosis, for the same thing is seen as an accompaniment of many other diseases, as acute catarrhal diarrhœas, acute poisonings, etc. The prodromic period exists in cholera nostras practically always, but not nearly always in true cholera.

The period of reaction is of importance in differential diagnosis. In cholera nostras it is usually benign—if the patient escapes the violence of the first attack, convalescence is as a rule easy and rapid; with true cholera, on the contrary, convalescence is exceedingly dangerous—full of pitfalls, and may terminate fatally at any time.

Mention of the disease is made in Sanscrit and Chinese writings. It is spoken of by Hippocrates (Epidemics), and successively by Aretæus, Celsus, Galen, Caelius Aurelianus, Aëtius, Paulus Æginatus, and Alexander de Tralles. All of these writers, with many others, refer to affections resembling the cholera, but it is not until the seventeenth and eighteenth centuries that we find descriptions of the *epidemic* disease. Genuine epidemics, analogous to cholera, are described by Rivière, who made his observations at Nîmes in 1564, and by Zacutus Lusitanus, who saw several in different parts of Europe in 1600. The most remarkable accounts by authors of this epoch are those of Willis ("Opera Gen.," 1680, t. xi., p. 74), describing epidemics in London, in 1670, of what he called "dysenterica aquosa epidemica," of Thomas Sydenham, in 1669–76 ("Oper. Med.," Geneva, 1723, pp. 106 and 184), and of Torti ("Therap. Spec.," liv. iii., cap. ii., and liv. iv., cap. j.). Bontius ("De Medic. Indorum.," Lugd. Batav., 1642, p. 136), Delon ("Voyage aux Indes Orient.," Amsterdam, 1684), and Thevenot ("Voyage aux Indes Orientales," Paris, 1689, tom. iii.) observed and described epidemic cholera in India. In 1761, Donald Monro ("An Account of the Diseases in the British Military Hospital in Germany," London, 1764, p. 97) saw an epidemic of cholera in Westphalia; as did Agton Douglass and Bisset, in 1768, in the north of England and in Scotland. Harlem ("Die Indische Cholera"

1831, t. i., s. 144) quotes many dissertations upon the disease, but it is not until the last century that we have a clear account of the transportation of the disease from place to place. From 1817 it seemed to take on a new power of travelling, and owing to this spread the opportunities for its study have vastly increased. The new methods of intercourse and commerce were probably responsible for the appearance of the disease in Europe—not any new property which it developed.

A study of the history of the epidemics that have occurred outside of India will easily demonstrate the facts in regard to the ways by which the disease is transported from place to place.

History of Epidemics of Cholera and Their Lessons.—The dispute is active as to whether true cholera existed in India before its appearance outside of its limits in 1817, but the probabilities are all in favor of its having done so, epidemics of considerable proportions being reported in the eighteenth century; the especial point that seems to be changed in its nature being that it then seemed to take on the property of migration. Whether this was in reality a new property, or whether, as is much more probable, it was simply brought to the notice of Europeans by their being first attacked by it, is an unsettled question. There is no doubt, however, of the very great influence exerted upon its spread by the great pilgrimages to the various shrines of India; nor is there any doubt that the sole home of true cholera—the one place where it is present all the year in an endemic form—is the delta of the Ganges. There are also certain places in India, Indo-China, China and Japan in which it seems to be present nearly all the time, but it certainly is not endemic in Persia, on the borders of the Caspian Sea, nor in Mecca.

From this one place in which it is endemic, cholera has always been transported to Europe in the steps of the traveller and along the routes of commerce; neither wind, moisture, electricity, nor any of the forces of nature have taken any active part in the actual transportation of the disease, although unfavorable climatic and hygienic conditions, of course, may play a favoring part in the development of the disease, after the arrival of its cause.

Epidemics of Cholera.—Cholera has made five appearances in Europe—in 1830, in 1846, in 1865, in 1884, and in 1892. Each one of these appearances was a great epidemic.

There had been also, in 1823, in Astrachan, a small epidemic of cholera, important because it traced the route that the succeeding invasions would follow. Leaving Persia, where it prevailed in 1822, cholera invaded the southern provinces of Persia, forming the southern shore of the Caspian Sea. After some ravages, it became quiescent during the winter of 1822, to reappear in April, 1823, at Recht. From this city, following the western shore of the Caspian Sea, it crossed the Russian frontier in June, at the little town of Astara. From Astara it reached Lenkoran on the 29th of June. On the 11th of September it was seen at Bakou, and on the 22d at Astrachan, where it soon disappeared.

The First Epidemic.—The epidemic of 1830 had the same origin. Ghilan and Mazanderan, the two Persian provinces before invaded, were attacked in 1829. The disease was quiescent during the winter, but appeared in the spring in Ghilan and in the little port of Enselli, situated several hours' journey from Recht. As in 1822, the cholera followed the western border of the Caspian Sea, and showed itself about the middle of June, 1830, at Salian. Taking here two different directions, on the one side it appeared at Bakou, Kouba, and Derbent, and invaded Astrachan; on the other, following the whole valley of the Koura, it advanced toward Tiflis, passing by Elizabethpol, and spreading throughout the whole of the Caucasus. In this way it reached successively the neighboring regions of Astrachan, and advanced up the Volga. On the 4th of August it was at Saratow, thence extending into Russia, and reached the other European States.

This epidemic, by certain extremely interesting peculiarities, demonstrated from the very first the transportability of cholera.

The Second Epidemic.—In 1846, after having reached Salian by a course identical with the preceding, cholera was seen on November 8th in the city of Chemacka, a short distance from Salian. It was in Bakou and at Derbent in December. Forgotten during the winter, it appeared in April, 1847, in the districts of Derbent and of Kouba, and at Tamir-Khan-Choury. From thence it was transported by sick soldiers to the mineral waters of Kisliar. The disease was disseminated among the Calmucks scattered over the steppes near the Volga.

On July 15th it appeared at Astrachan, and advanced at the same time toward Tiflis. From Tiflis it reached Koutais, and was soon carried to Trebizond.

North of Tiflis, the cholera followed the great military road that crosses the Caucasus at the height of seven thousand feet, and toward the end of July it existed at Stavaropol, on the other slope. (It is to be observed that before reaching Tiflis, the cholera entered Persia by the great routes of travel that pass from Bakou, by Erivan, Natchichievan, Djoufa, Ordoubaz, and on toward Tauris. On the one side it attacked the region of the Black Sea, and invaded all its ports; on the other, it passed through Russia, Germany, France, and Italy.)

A striking thing about these epidemics, aside from the exact places that they attack, is their progress by successive stages—a form of advance that is always the same, and which is a trait common to all the epidemics of cholera that have followed the land route. This second epidemic persisted until 1855.

The Third Epidemic.—The great epidemic of 1865 was the first one appearing by the sea route. It demonstrated that the danger is not localized on the Caspian Sea, but that it is also present on the shore of the Red Sea. Its appearance by this route upset all the doctrines that had been held until that time, and the panic that it produced in Europe resulted in the first conference at Constantinople. It is interesting to follow in some of its phases the course of this epidemic, because its influence has been great. It started from Mecca, having been brought into that city by ships coming from India filled with pilgrims. Toward the end of April it broke out in Mecca and at Medina. The mortality increased very greatly during the three feast days at Arafat. More than thirty thousand of the pilgrims died of cholera, and the progress of the disease showed that *everywhere it accompanied these pilgrims*. Egypt, by reason of its proximity to Mecca, was the first country attacked.

From May 19th to June 10th ten steamers landed from twelve to fifteen thousand pilgrims at Suez. By false declarations from the captains they were passed at Suez, although the *Sydney*, an English steamer, had lost a number of cases during the voyage. The first steamer, landing May 19th at Suez, had thrown its dead into the sea. On the 21st, cases appeared at Suez, and among the number were the captain of the vessel and his wife.

June 2d, the first case appeared at Alexandria, and in two months cholera had four thousand victims in Alexandria, and in Egypt, in less than three months, it produced the death of more than sixty thousand individuals The foreign population emigrated *en masse*, and carried with them throughout the entire world the germs of the disease. Europeans and Levantines, to the number of from thirty to thirty-five thousand, started for all the ports of the Mediterranean, and cholera developed at Constantinople, at Smyrna, at Beyrout, in Mesopotamia, and at Odessa on the Black Sea, and was carried to New York and Guadaloupe by steamers, *appearing in the port at the same time that the steamer landed its passengers*.

Its importation into New York was as follows: The *Atlanta*, an English ship, left London on October 10th with a cargo of merchandise and forty passengers. The sanitary condition of London was at that time excellent. Reaching Havre on the 11th, where it remained one day only, it embarked five hundred and sixty-four new passengers, mostly Swiss, who had all passed through Paris, where, with certain exceptions, they had remained at

least a short time, and where at the same time cholera was raging with great intensity. Two German families had stayed in Paris at the Hotel of La Ville de New York, and five days at the hotels of the Weissen-Lamm and Hultgarderhof. Some emigrants that had arrived several days before in these last hotels had fallen suddenly ill. The steamer sailed on the 12th, and on the next day there was a death from cholera of a child in the family coming from the Weissen-Lamm Hotel. Five other deaths followed on the 14th, the 16th, the 18th, the 19th, and the 22d, in the family that had stayed at the Hultgarderhof.

On the arrival of the *Atlanta* the surgeon declared 60 cases of cholera, and 15 deaths during the voyage. Two deaths occurred in port, and of the 142 patients sent to the Marine Hospital from November 6th to 19th, 6 died, which makes a total of 23 deaths. The *Atlanta* was immediately isolated in the lower bay, and after ten days of quarantine all the sick were removed, and, thanks to these measures, New York was preserved.

There were also importations in 1866 by the steamers *Virginia* and *England*.

The epidemic of 1865 ceased in 1874, and there was no other case seen in Europe until 1884, although there were interesting manifestations in other countries and on the sea—interesting from the point of view of the transportability of the disease.

The Fourth Epidemic.—The epidemic in Egypt in 1883 was no surprise to those who knew the sanitary condition of the country. Cholera appeared at Damietta toward June 19th or 20th, possibly a little earlier, and its explosion at this time is ascribed, certainly by the French, to the suppression of all sanitary precautions, including quarantine, by authority of the British Government. This epidemic at Damietta increased for about fifteen days, remained stationary for about five or six days, and then diminished just as speedily. It was almost extinct a month after its appearance, having claimed from two thousand to twenty-five hundred victims. The spread of the disease throughout Egypt was manifest and rapid. (An interesting account of how this epidemic reached Damietta is given in Proust's work on the "Defence of Europe against Cholera," Paris, 1892, p. 7.)

Cholera had not yet died out in Egypt, before the news came that it had broken out among the pilgrims to Mecca, and there has been much discussion as to the origin of this epidemic.

In 1884 a number of vessels left the extreme East, and had cases of cholera on board during their voyage; but, by reason of the precautions taken, Egypt and Europe escaped the danger at this time.

The first case of cholera seen at Toulon occurred on June 13th, on the ship *Montebello;* a second case on June 14th; a third on the 18th, on the *Jupiter*, near the *Montebello;* a fourth, also on the 18th, on the *Montebello;* a fifth, June 20th, on the *Alexander*, which was also placed near the *Jupiter* and the *Montebello*. After the 21st the disease spread through different quarters of the city, and it is thus shown that it did not make its appearance at Toulon in the city, but just outside.

Its importation into Marseilles occurred by the appearance of the first case on June 27th, in a young man, who had three days before come from Toulon. The next case, which occurred on June 28th, was that of a man who lived in the same neighborhood; and from this time onward the disease continued to spread.

In Paris there appeared two cases on the 13th or 14th of July, but the epidemic did not really begin until the 4th of November.

In Brittany the first case was not observed until September 20th, at Concarneau. Other ports were successively invaded.

Algeria was attacked in 1884, and there was a slight recurrence in Algeria and in Tunis in 1885.

Cholera was brought to Italy in 1884 by the Italian workmen, who, to the number of more than eight thousand, returned to their country after the extension of the cholera to Toulon and Marseilles. The province of Cuneo, in Piedmont, was the first one attacked, on June 27th, and the disease spread successively to different parts of Italy, to Genoa, Naples, Venice, Sicily, and so on.

It appeared in Spain, in the month of August, in the province of Alicante, and ceased toward the middle of October, reappearing in the middle of February, in the district of Gandia, raging through the month of June to the month of December, 1885, and producing a considerable mortality. It is remarkable that it attacked especially the small towns more than the large cities. The Commune of Aldea de San Miguel, with only five hundred inhabitants, lost more than half of them in thirty-six days.

Cholera also appeared on the Adriatic shores of Croatia, at the end of 1885, and in 1886 on many points of the Austro-Hungarian shore in Istria and in Dalmatia.

The comparison of the mortality in France, Italy, and Spain is interesting. In France and Algeria together there were 13,000 deaths in a population of 39,000,000—1 in 3,000 inhabitants. In Italy there were 35,000 deaths in 26,000,000, that is to say, 1 death in 600 inhabitants. In Spain there were 180,000 deaths, among 17,000,000 inhabitants, that is to say, 1 death in 100 inhabitants. So it appears that Italy was attacked five times more severely by the epidemic than France, and Spain six times more severely than Italy, and thirty to forty times more severely than France.

Much has been said about the immunity of Portugal during the epidemic of 1884 and 1885 in Spain. Many reasons can be brought forward for this, viz., the slight tendency of the Spaniards to take refuge in Portugal, the geographical conditions, and finally, the prophylactic measures taken at the frontier.

In spite of the imperfect quarantine and incoherent measures prescribed by the governments of South America against the vessels coming from Europe, a ship from Genoa, the *Perseo*, carried cholera to Buenos Ayres, and the disease spread into the Argentine Republic, Uruguay, and Chili.

From 1884 to 1886, a period of three years, more than twenty vessels coming from the extreme Orient to Europe, on passing through the Red Sea and the Suez Canal, had, either at the moment of their departure or during the voyage, cases of cholera.

The Cholera of 1889, 1890, 1891, *and* 1892 (*the fifth epidemic*).—In 1890 cholera appeared in Irak-Arabi, in Mesopotamia, in Persia, and in Syria, where it had not been seen for almost twenty years. It had been imported into the region bordering on the Red Sea and into Mecca, where it had not been since 1883, and it was observed in Spain, where it had been extinct since 1885.

In summing up what we know of the origin of cholera in Irak-Arabi and in Mesopotamia in 1889 and 1890, the following must be our conclusions:

It is very difficult to admit that the cholera of Irak-Arabi can be attributed to the revival of the old epidemic of 1871, and if this hypothesis be excluded, we are obliged to accept the idea of importation, and it is only possible to think of one portal of entrance, the Persian Gulf, and one source in India, namely Bombay and its environs.

We know from other sources that during and before the appearance of cholera in Irak-Arabi the mortality of this disease in Bombay and its environs reached the enormous number of more than six hundred deaths a week. The condition of the vessels of the British India Company, that alone regularly frequent the Persian Gulf, bring passengers there, and frequently bring pilgrims from India, has been, to say the least, suspicious. Everything points therefore to the conclusion which bears every appearance of truth that the cholera penetrated into Irak-Arabi through Chat-el-Arab. The importation was performed in this way much more probably than by any other means.

In regard to the epidemic of 1890–91 in Hedjaz, Proust offered to the Committee of Hygiene the following conclusions which were accepted: (1) The cholera of Cameran was imported by an English vessel coming from India; (2) the cholera of Hedjaz appears to have been brought by the sea route; (3) the pilgrimage to Mecca is a constant menace to the health of Europe; (4) the measures prescribed for the government of the pilgrims to Mecca have not prevented the cholera from developing, and it is therefore necessary to perfect these measures; (5) the prophylactic measures prescribed by the Alexandrian Conference at the time of the return of the pilgrims, have this year prevented the disease from gaining a foothold in Egypt and in Europe. There is reason, therefore, for continuing this conference and for giving it more authority and making it in reality international. There is also reason for increasing the means for isolation and disinfection on the Red Sea.

The epidemic which appeared in Spain in the month of May, 1890, and lasted until the end of November, gave rise to much discussion in regard to its origin, a discussion that reached no final conclusion.

In 1890 cholera also appeared in Japan, beginning in June and lasting throughout the year. Over 46,000 cases were reported. The epidemic of 1892 appeared first in Southern Russia and thence spread to isolated parts in the north of Europe, notably Hamburg, where it continued, with declining severity, into 1893 and 1894.

In September, 1892, 10 cases, with 8 deaths, occurred in New York, being imported from Hamburg, or probably derived from such imported cases, and 73 cases, with 43 deaths, occurred in the harbor, together with 56 suspicious cases of disease thought to be cholera. In 1893, 23 cases, 4 fatal, occurred in the harbor, and one death, verified by bacteriological examination, took place in Jersey City, where there were also 6 deaths following a disease clinically diagnosticated as cholera. Since then no cases have occurred in this country.

In 1895 there were serious epidemics in China and Japan, over 12,000 cases, with over 8,000 deaths, being reported from the latter country.

In 1896 cholera appeared in Russia, Turkey, Egypt, and a few cases in Austria. During the years from 1897 to 1901, inclusive, cholera does not appear to have spread beyond the regions where it is endemic, except a few cases imported from those places.

In 1902 cholera assumed epidemic form in Mecca, Turkey, Russia, Japan, and China. There were also a few cases in Egypt and other southern Mediterranean countries. In the Philippines, between March 20th and the end of October, over 4,200 cases, with more than 3,300 deaths, occurred in Manila, and in the provinces outside of that city over 102,000 cases, with between 66,000 and 67,000 deaths. Since that time, and into 1903, cases of cholera have occurred in these islands. The first case came from Hong-Kong.

Transportability and Means by which the Disease is Transported.—The transportability of the disease is demonstrated by, first, the facts in regard to its propagation after it has been imported; second, by the efficacy of certain measures of prevention; third, by the general march of epidemics of cholera; and fourth, by the development of epidemics in the infected localities.

1. *Propagation.*—Brochard, in "Du Mode de Propagation du Cholera," Paris, 1861, reports a very large number of observations favoring the idea of the transportability of cholera, and the number of instances proving this is so great that they need only to be spoken of to be accepted.

An illustration may be taken from the article by Huette, in the *Arch. Gén. de Méd.*, 5th series, vol. vi., p. 571.

In speaking of cholera in Chatillon, he says that the first case was observed in the Faubourg du Puirault, in a workman, thirty-five years old, who was attacked immediately after his return from Oussoi, where he had gone to take care of his parents who were sick with the disease. His neighbors were very soon attacked, and the epidemic invaded the entire Faubourg du Puirault, where it remained concentrated for some little time. Finally the inhabitants, frightened by the disease, scattered through Chatillon, and the cholera appeared indiscriminately throughout the city. The instance is interesting, because while the inhabitants remained in the Faubourg du Puirault, the disease stayed there, whereas, as soon as they scattered, it spread with them throughout Chatillon.

Another instance, interesting as an example of the transmission of the disease by clothing, is given by the same authority, in speaking of the Commune of Oussoi. Madame Bresson, of the hamlet of Moulineuf, near Oussoi, a precinct free from cholera, received a boarder from Paris, June 27th, who on the next day showed the first symptoms of cholera, and died on July 3d. Some days after, a child of this woman was attacked and died on July 13th. On the same day Madame Bresson herself was taken sick, and died on the 17th, after having been taken care of by two neighbors named Sahan and Moret, who died, one on the 16th and the other on the 24th. The husband of Madame Bresson died on July 26th. Madame Burette, who lived in the extreme end of the hamlet, washed the linen of the two women, Sahan and Moret, and was attacked with cholera. In this way, an epidemic was started that carried off eighteen persons in a very short time. Before the arrival of the person from Paris no case had been observed in this hamlet, that had been spared by the cholera both in 1852 and in 1849. Dr. Huette calls attention to the distribution of this hamlet of Moulineuf, which is composed of ten little collections of houses, separated by great distances. No cases of cholera were observed excepting in three of these collections of houses—first, that occupied by the Bresson and Sahan families; second, that occupied by the Moret family; and third, that occupied by the Burette family. The third collection of houses was situated at the extremity of the hamlet. No case of the disease was observed in the other houses, of which the inhabitants had had no connection with these three families.

Proust (*loc. cit.*, p. 165) quotes an occurrence illustrating another series of facts.

In 1854 the French army was collected at Varna, a short distance from the English army. Some detachments remained at Gallipoli, the original place of debarkation. There were, besides, a small Anglo-French force of occupation in the Piræus, and also some detachments at Constantinople. The armies were reinforced practically every day by new arrivals. The sanitary condition was satisfactory in all respects. On July 5th the packet *Alexandre* arrived at Constantinople, having left Marseilles on June 26th with five hundred men of the Fifth Regiment of Light Infantry, coming from Montpellier, and having passed through Avignon, where cholera was raging. It appeared on board, and three men died during the voyage to the Dardanelles. Four cholera patients were landed at the Piræus, where the cholera broke out immediately, and made great ravages. The troops were disembarked at Gallipoli, where two new cases of cholera were immediately sent to the hospital, and the ship, having only a few passengers on board, sailed for Constantinople, where a quarantine was imposed on it. On the other hand, it appeared that previous vessels sailing from Marseilles had already suffered from cholera, and that one of them had landed a patient in the military hospital at Constantinople. On July 15th, after new arrivals of cholera patients, the disease spread at Gallipoli, and there appeared in the military hospital of Constantinople a choleraic focus. Fauvel, struck by the danger, proposed, and had adopted by the Council of Health at Constantinople, a momentary interruption of the communication between Gallipoli and Varna. The measures prescribed were not executed, and in spite of the insistence of Fauvel before the Marshal de Saint Arnaud, many ships sailing from Gallipoli passed the Bosphorus, and went directly to Varna, where free pratique was accorded them. Cholera then broke out in the army among the newly arrived soldiers and in the hospital. On August 5th the epidemic was violent at Varna, especially among the troops sent into the Dobrudscha. The English army was invaded, having the epidemic on board the fleet. In the Crimea, the epidemic,

helped on by the arrival of the fresh troops, continued until 1856.

The importation of cholera into Constantinople in 1865 equally deserves to be spoken of. Constantinople was in an excellent sanitary condition when the frigate *Moukbiri-Sourour* arrived from Alexandria, on June 28th, 1865. She had passed more than five days on the voyage, and therefore, in accordance with the rule that then held, free pratique was granted her, the surgeon having declared that there had been no illness during the voyage; but this declaration was false. The evening of June 28th there were landed from this frigate twelve sick persons, of whom one was attacked with cholera, who died during the night, and eleven were affected with cholerine. It was learned on the next day that during the journey from the Dardanelles to Constantinople two choleraic bodies had been thrown into the sea. On June 30th nine other cases were landed. The ship was sent into quarantine at the mouth of the Black Sea. The patients were transported to the Marine Hospital, near the arsenal, and here one special circumstance should be noted. The road that went from the landing to the hospital being opposite, it was necessary to carry the sick past the barracks occupied by military workmen in the arsenal, and the first indigenous cases of cholera occurred among these workmen, and on board a corvette that was near their barracks. On July 3d one of these military workers was received at the hospital with a choleraic diarrhœa, and on the 5th presented all the symptoms of cholera. That same day a new case was furnished by the workmen, and another on the corvette spoken of above. The barracks were then vacated, and the workmen were placed in tents on the heights of Okmeidan; nevertheless, the disease continued to rage among them, and among the ships collected before the arsenal, and it attacked on the one hand the guard in the interior of this establishment, and on the other the workmen at the Ministry of Marine, situated very near the barracks of the military workmen. On July 8th two cases occurred outside the arsenal, and from July 10th the epidemic commenced to invade the quarter of Kassin-Pacha, near the arsenal, and inhabited by the workmen of whom we have spoken. It then propagated itself throughout the city.

One more instance of the importation of cholera may be given, as illustrating that a single case, carried a great distance by rail, may give rise to an epidemic.

Toward the end of the month of August, in 1865, cholera suddenly broke out at Altenburg, in Saxony, in the centre of Germany. The first case was that of Lady E——, who had left Odessa on August 16th, and had arrived at Altenburg on the 24th, without having stopped on the journey. She travelled with a child of twenty-one months old, who was affected with diarrhœa. She went to her brother's, and sent for a physician to see her child, whose diarrhœa had become very severe. This woman, who was meanwhile well, said that at her departure from Odessa there had not been in that city any disease; but this was an error, for some cases of cholera imported from Constantinople were already in the hospital in the lazaret, and, the day after the departure of this lady, cholera appeared at Odessa. She said also, that having embarked to go up the Danube, everybody appeared to her to be well on board, although the vessel had passed by certain localities where cholera was raging; however that may be, three days after her arrival at Altenburg, on August 27th, and the very same day that the physician had visited her child, this lady fell ill, and the next day the physician recognized all the symptoms of Asiatic cholera. She died on the 29th. On the same day, in the same house, her sister-in-law was attacked, and died on the 30th. The child died on the 31st. From this house the cholera spread into the city and suburbs. The family of a workman, who died on September 13th at Altenburg, carried the disease to Werdeau, and the house occupied by this family was the point of departure of another epidemic that carried off two per cent. of the entire population of the city.

2. *The Transportability of Cholera is Confirmed by the Results of Restrictive Measures.*—We see always that a rigorous sequestration and a rigorous interruption of communication by land or sea, if that be possible, result in preserving certain places or certain countries, and in these facts is a powerful argument against any idea of the transmission of cholera through the air.

In 1867 Messina and the whole of Sicily were entirely free from cholera, and yet vessels coming from infected countries daily passed through the narrow Strait of Messina. And again, during the epidemic of 1856 at Constantinople, the scholars of the Military School, to the number of five hundred, were rigorously sequestrated in the establishment, and escaped the cholera that was raging in the neighborhood; and events that occurred at the lazaret of Fort Genoa, in Algeria, in 1884, demonstrated also the efficacy of isolation in order to prevent the transportation of the disease to the neighboring cities.

3. *Transportability as Shown by the General Progress of Epidemics of Cholera.*—If we look at epidemics as a whole, we see that they always follow the course of human currents of travel. It is in the East, or in the countries bordering upon Europe, that we can best follow the development of this law, because in such places the routes are less frequented, and the demonstration is more striking. In order to pass from Persia into Russia in any way except by the great line of travel passing through Erzeroum, Tauris, and Natchischevan, there are only two ways—that over the Caspian Sea, and the land route that follows the western shore of this sea. Both of these routes pass by Recht, Astara, and Lenkoran, and end both of them at Bakou, and in the same way cholera, in the epidemics of 1823, 1830, and 1846, always and invariably passed through Recht, Astara, Lenkoran, and Bakou. At the latter city the land route splits on the north. It continues to follow the western border of the Caspian Sea, and passes by Derbent, and reaches Astrachan exactly as does the sea route, and we have seen cholera at every one of its appearances, in 1823, 1830, and 1846, travel over this same line, passing by Bakou, Derbent, and Astrachan. In 1823 it stopped at Astrachan, while during 1830 and 1846 Astrachan was only one of the steps of its invading march.

The second line of travel passes over the Caucasus. It leaves Bakou, passes by Tiflis, and follows the Caspian Sea to the Black Sea. The point of departure from the Caspian Sea is Bakou. The point of arrival on the Black Sea is Poti, or Trebizond. The epidemics of 1830 and 1846 divided, following both of the two routes that have been spoken of. One current followed the border of the Caspian Sea, another crossed the Caucasus.

This progress of cholera, always following the same lines, is a striking illustration of the law formulated. It always follows the human currents, in the steps of the traveller. It is imported by man alone, and precisely the same point is shown if we follow the successive steps of the epidemics that have travelled by the sea route.

As an illustration, the epidemic of 1854 in the Crimea was due to vessels coming from Marseilles, and carrying troops from an infected country. Cholera appeared successively at every one of the points where these vessels touched. They landed at Messina, and Sicily was invaded. They touched at the Piræus, and Greece was attacked. They stopped at Gallipoli, and cholera appeared at Gallipoli. Constant communication was being held between Gallipoli and the Dardanelles, Constantinople, and Varna. Cholera developed at all three places. The same was shown in the progress of the epidemic of 1865. It must not be supposed, however, that the assertion is made that cholera took the special direction from east to west; on the contrary, it radiated from India in all directions—north, south, east, and west—according to the ease and number of the means of communication.

4. *Transportability as Indicated by the Evolution of Epidemics in Infected Localities.*—Many examples of this may be quoted, among which are the following:

In Constantinople it is possible to trace out the successive extension of the disease up to the time of its general diffusion. At Constantinople it manifested itself first at

the arsenal, where it had been carried by the sick who were landed from the ship *Moukbiri-Sourour*. From the arsenal it reached the neighboring quarter of Kassin-Pacha, and then a few cases appeared in different parts of the city, for the most part of persons who had fled from the quarter first attacked. Up to July 16th the total of the deaths from cholera in the entire city, except those at the Marine Hospital, reached one hundred and thirty, when suddenly it was learned that the disease had broken out with violence at Eini-Keni, a village situated on the Bosphorus, twelve or fifteen kilometres from the quarter where the epidemic had begun. It was established that the first case of cholera had appeared on July 11th, in a Turkish café, in a workman coming from Kassin-Pacha; that on the next day many of the individuals who frequented this café fell ill, and two died; that during the following days the disease was propagated in the quarter until the 16th, when, after the occurrence of several deaths among prominent families, a panic seized the whole population of the village, who fled in all directions. Mussulmans, Greeks, Armenians, and Jews fled into other villages and other quarters of the city which were then unaffected, but in which the cholera speedily made its appearance. The Jews in particular, who had been the most seriously attacked, and who carried with them their soiled clothing and their dead, became the special propagating agents of the disease. At Koustoundjouc, at Kas-Keni, and at Bulata, the epidemic broke out immediately after the arrival of these fugitives. From this moment dates the generalization of the epidemic. It is not necessary to add other examples. The same thing is shown in the history of every local epidemic that has been intelligently traced.

It has been opposed to this idea of the transportability of cholera that sometimes a restricted intercourse has failed to arrest the progress of the disease; but in all these cases the measures were either tardily employed or applied without scientific rule. Others have spoken of the immunity of countries which had not protected themselves by any sanitary measures. The answer to this is the question, whether cholera, although it is a disease capable of spreading by infection, must, therefore, be possessed of a method of forcing this infection. And, in conclusion, no matter what the differences of opinion are, the law of transportability remains absolutely established by all the facts yet obtained in regard to cholera.

Methods of Transportation of Cholera.—In a consideration of the question of the method of transportation of cholera, we are to look at two principal points, the agent of cholera, that is, the organism of the disease, and second, the medium.

The agent of cholera is unquestionably a bacterium, having India for its origin. It extends itself, and reproduces itself indefinitely, and many media serve as vehicles for its transportation throughout the entire world, but this choleraic agent would be wholly powerless if it did not encounter favorable conditions for its development. The medium, therefore, is indispensable to its power, and this favorable medium is made up of certain telluric conditions, the surroundings, and so on. So far as the methods of transportation of cholera are concerned, therefore, we have to consider more the medium in which it appears than the cause of the disease itself. Fauvel has expressed this truth as follows: "That a fire is not proportionate to the spark which gives it birth, but to the combustibility and mass of the material that it encounters." So, frequently, a few cases, or one only, as at Altenburg, are sufficient to produce the explosion of an epidemic.

The clinical consideration of the means of transportation of cholera is to be made under the following headings:

First, the transportation by men attacked by cholera, and the rôle played by the closets that have received choleraic excreta. A person arriving from an infected place is always necessary for the beginning of an epidemic. In other words, man himself is the most powerful agent for the spread of cholera, the specific microorganism being found, as has been demonstrated by innumerable experiments, in the excreta. Washerwomen have been attacked by the disease after washing linen soiled by evacuations, while others, who had simply touched this linen, also contracted the malady. Budd relates (quoted by Hirsch in *Schmidt's Jahrbücher*, vol. xcii., p. 255) that in 1854 a person affected with cholera arrived in an English factory of six hundred and forty-five workpeople. There followed one hundred and forty-four deaths from cholera in five weeks. The disease developed solely among those who made use of the closets where choleraic dejecta were deposited. Instances of this kind can be multiplied almost indefinitely.

Second, the transportation by means of choleraic diarrhœa. As illustrations of this, innumerable instances might be quoted, especially that mentioned by Budd in the reference given above. A person sick of diarrhœa came into the midst of a perfectly healthy population in a colliery, and died. Diarrhœa became general, and seventeen persons contracted cholera. The case of Dr. Alexander, in the *Gazette Médicale* for 1849, is also an illustration of this point. There was not at Hamel, a village twenty-five kilometres from Amiens, any indication of cholera, when, on April 4th, from Paris, where cholera existed, there arrived a soldier sick with diarrhœa. He was received into his parents' house where he remained three days. On the 14th he went to the Hôtel Dieu, and the same day his brother, who had come a number of times to see him, was attacked by foudroyant cholera and died in twelve hours. His wife died three days afterward. The father, who had shown some symptoms of cholerine, was attacked with cholera on the 11th, and died on the 15th. Another son of this man, seventeen years old, and a child of four years, his grandson, were attacked with cholera and got well. The father-in-law of the brother who had taken care of him and his daughter were attacked by cholera, but recovered. A child of eleven years, who was often at the house and whose parents had taken care of the same brother and his wife, was attacked on the 14th and died the following day.

Third, Can the bodies of persons dead of cholera communicate the disease? Although the evidence seems to point toward this being a possible danger, it is not a serious one in civilized countries.

Fourth, Can cholera be transported by healthy individuals? This must be answered in the negative. The facts quoted that seem to show that this may occur, must be explained by supposing that the individuals who were believed to be entirely well were in reality sick of a choleraic diarrhœa, or else that they carried clothing or linen soiled with choleraic material. The studies of cholera during 1892–93 in Europe have shown that the cholera vibrios may be present in the dejecta of people apparently healthy, with well-formed stools, as well as in those who are suffering from a mild diarrhœa without other notable symptoms. These vibrios were virulent and presumably capable of inducing severe cholera in more susceptible individuals.

Fifth, Can cholera be transported by living animals? Animals are not susceptible to the disease. A certain number of experiments have succeeded in producing cholera in animals, but with great difficulty. There is no fact to support the supposition that animals can carry the disease, either on the skin or in the hair.

Sixth, the transportation of cholera by means of clothing, personal effects, and so on. The disease cannot be so transported unless these materials have been contaminated by cholera dejecta. This, of course, is an exceedingly important point, for if soiled, the material may be dangerous; if it is not soiled, there is no danger at all, even if it comes from cholera centres. It is of equal importance to know whether contaminated objects have been packed up or exposed to the air. A contaminated object exposed to free air for a definite time loses its power of transporting the virus. The conference of Constantinople considered that a very short time was sufficient to do away with all danger, and recent bacteriological research