of the closed hand by placing in the palm of the hand, between the thenar eminence and the second phalanges of the flexed fingers, the handles of the dynamometer *crossed*. Secondly, it is designed to measure the force of

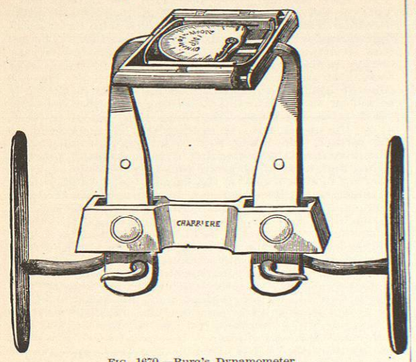

FIG. 1670.—Burq's Dynamometer.

the movements of parts. Then its handles should be uncrossed. For example, if we desire to measure the force of the movement of flexion of the lower arm, we fasten something to the end of it (a handkerchief folded crossways or a strap), to which we can attach the handle of one of the branches; then, while the subject holds the forearm powerfully flexed, the operator seizes the handle of the free branch and pulls on it until the forearm begins to extend. The sensitive dynamometer, of a form analogous to the preceding, is designed to measure in grams the force of partial movements in persons who suffer from paresis. Thirdly, the movable needles are designed to measure the force of the nervous excitability.

The instrument (see Fig. 1671) is composed of: (1) A powerful spiral spring, which ends in two straight branches (*0, 0*) placed side by side and parallel—the spring is made tense by the separation of these branches; (2) two handles (*P, P*), which are fixed at will either at the extremity of the branches or near their central point, and by means of which the branches can be separated; (3) a plate (*C*), placed on the anterior face of the spring, and on which are engraved two rows of numbers (*A, B*), marking in the first from 1 to 100 kgm., in the second from 1 to 40; (4) a needle (*D*), which is set in movement by the separation of the branches, and marks the amount of force which causes this separation.

Dönhoff's myodynamometer was designed to "determine with mathematical exactness the degree of muscular power in disease." The instrument acts on the lever principle. A bar fifty-five inches long, with a notch five inches from one end, is so placed that the notch fits into the corner of a prism-shaped support on which the bar can be moved as a lever. The long arm of the lever contains fifty notches an inch apart, and on any of these a ten-pound weight can be suspended. The beam itself can be held in equilibrium by a two-pound weight fastened to the end of the short arm. In order to use the instrument it should, if possible, be placed on a table near which the patient sits. He presses with his right hand on the short arm of the lever, while the physician places the weight so as to neutralize the pressure. The limit of the muscular power stands at that point at which the patient is no longer able to keep down the short arm of the lever.

Among dynamometers for special purposes mention should be made of Mallez' vesical dynamometer, intended to measure the muscular force of the bladder. It is composed of the following parts: (1) A tube 0.04 mm. long, and 0.01 mm. in diameter; (2) a little cap, which forms one of the extremities of the tube, extends into it, where it moves up and down with slight friction, and receives the shock of the column of liquid; (3) the cap is surmounted by a rod, surrounded by a spiral spring of known resistance, and this rod extends a certain distance beyond the farther extremity of the tube; (4) a pin placed on the rod at its exit from the tube is in contact with the shaft of a needle, and communicates to it the upward movements of the rod. The divisions of the dial over which the needle plays indicates the degrees of impulse, and the point of stoppage shows the measure of the greatest force developed.

All the instruments hitherto described are more or less complicated or designed for special purposes, and they are not much used at the present time. On the other hand, their place is supplied by simpler and less costly instruments. Mathieu's dynamometer, which is now in general use, is a modification of Régnier's, in which the dial, instead of projecting beyond the spring, is placed between its branches, making the instrument smaller and easier to handle. As it is intended only for medical use, the spring need be only of a moderate resistance. The dynamometer of Robert and Collin is practically the same as that of Mathieu (see Fig. 1672).

Dr. Græme Hammond, objecting to the fact that the hand of the patient sometimes covers the dial plate in Mathieu's instrument, so that the steadiness of the muscular contractions cannot readily be perceived, has, in his form, placed the dial plate at one extremity of the ellipse instead of on the side, as does Régnier. In his instrument the dial plate has the double rows of figures, which should be used on all dynamometers, and, the plate being larger and the hands longer than in the ordinary form, smaller degrees of pressure can be registered.

Hamilton's dynamometer consists of a graduated glass tube which dips into a rubber bulb. This bulb is filled

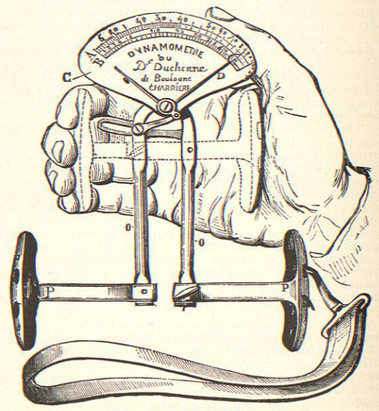

FIG. 1671.—Duchenne's Dynamometer.

with colored water, which rises in the tube when the bulb is compressed. Hamilton thinks that the rubber bulb is better adapted to receive pressure exerted by all

the flexors of the hand than is the spring dynamometer, which is acted on by only some of them.

The uses of the dynamometer, from a medical point of view, have already been indicated. In disease it is used frequently to determine the amount of muscular force in muscles or series of muscles, either by comparison of those on the one side with the corresponding ones on the opposite side, or by comparison with the standard of

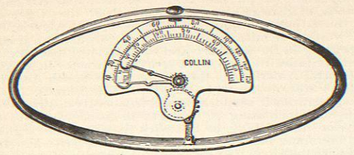

FIG. 1672.—Dynamometer of Collin.

health. It is of greatest value in cases of partial paralysis, in which it is desirable to test more or less accurately the strength of special muscles. In this way it is used as a means both of diagnosis and of prognosis. In health, also, the dynamometer has been frequently used: 1. To determine the average power which the human body can exert during a given time. Thus has been calculated the average amount of labor of various kinds which can be performed in a day. 2. As a method of selection for special duties.

In regard to the muscular power of men as determined by the force of the hand grasp, Rey gives the following table, which he obtained from the examination of seamen in the French navy or applicants for the service:

REY'S TABLE.

Number of subjects observed.	Ages.	Mean muscular power in kilo-grams.	Number of subjects observed.	Ages.	Mean muscular power in kilo-grams.
1	10.5	20.00	2	21.5	40.00
1	12.0	15.00	10	22.0	43.20
2	14.5	21.50	1	22.5	45.00
2	15.0	27.50	8	23.0	39.75
1	15.5	22.00	2	23.5	41.00
8	16.0	32.06	4	24.0	42.75
4	16.5	37.75	2	25.0	37.50
41	17.0	36.92	1	25.5	46.00
29	17.5	35.82	1	26.0	40.00
47	18.0	34.72	1	26.5	44.00
17	18.5	38.94	3	27.0	44.00
41	19.0	38.80	1	27.5	40.00
2	19.5	40.00	1	28.0	35.00
36	20.0	40.61	4	29.0	37.25
23	20.5	40.14	2	30.0	45.00
51	21.0	40.70	1	36.0	42.00

Mean between ages of	10	and	20	31.54 kgm.
" " "	15	"	20	35.75 "
" " "	20	"	25	41.11 "
" " "	20	"	30	41.25 "
" " "	25	"	30	41.40 "

Mathieu's dynamometer was used. The subject standing firmly, seized the instrument in the palm of his hand, and was asked to exercise progressively the strongest pressure of which he was capable. Rey concludes that the mean muscular power of a man 19.5 years old, as measured in this way, equals 38.17 kgm. Michéa quotes Maréchal to the effect that 28 kgm. is the maximum effort that a cannonier should use to execute a manœuvre, and 21 kgm. the mean. He states that in good health a man has a power of pressure equal to 50 kgm., and a force of prehension equal to 132 kgm. A woman has about two-thirds that of a man.

The average daily work of men has been carefully determined in various ways. A table giving the results obtained may be found in the ninth edition of the "Encyclopædia Britannica," article "Mechanics."

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DYSCRASIA. See *Diathesis.*

DYSENTERY.—HISTORY.—Dysentery was one of the best known of the diseases of the ancient world. It was noticed before the time of Hippocrates (430 B.C.), but this writer was the first to give an accurate description of its symptoms. He clearly differentiates it from diarrhœa, as the following extracts from his works show: "But when the body being heated, acrid matters are discharged, the intestine is excoriated, ulcerated, and the stools are bloody; this is dysentery, a grave and dangerous disease." "When there is dysentery, pain occupies the whole abdomen; bile, phlegm, and heated blood are discharged." From the time of Hippocrates to that of Celsus (25 B.C.–45 A.D.), the contention of schools and theorists did but little to advance medical knowledge, but the writings of the medical Cicero, as Celsus has been called, may be said to epitomize the learning and practice of his predecessors, and that the chief features of dysentery were then understood, this quotation from his works well illustrates: "The next disease of the intestines is usually called tormina; in the Greek language it is termed dysenteria. The intestines are ulcerated internally; grumous evacuations come from them; sometimes the excretions are mixed with fæcal matter always liquid, at other times the discharges are slimy; sometimes particles like flesh pass with them: there is a frequent desire of going to stool, with pain in the anus; with this pain a small portion is voided, and even by this the pain is augmented; that is relieved after some time, and then there is a short repose. The sleep is interrupted, slight fever ensues, and in the progress of time that disease either destroys the patient, when it has become inveterate, and even although it may be terminated exerts a baleful influence for a long time." Aretæus (50 A.D.) recognized, without doubt, by actual observation, that the ulcer was the peculiar and dangerous lesion of the intestine in dysentery. Matters resembling flesh, he says, come away in the discharges which accompany ulceration of the lower bowel. The flesh-like masses are shreds of the lining membrane of the intestine; healing takes place by granulation and cicatrization of the outer coat, which remains intact. That he also observed the lesions of typhoid fever, and appreciated their relation to continued and dangerous fever, is proved by the statement that, if the ulcers in the small intestine become excavated and phagedenic, acute fevers set in, which in some cases are latent and smoulder in the intestines; in other cases ardent fevers occur, accompanied by prostration of strength, thirst, anxiety, dry tongue, and small, feeble pulse.

A century later, Galen (164 A.D.) said that the physicians of his time limited the term dysentery to cases of intestinal ulceration. The shreds passed from the bowels are scrapings from the internal membranous surface of the intestine. "At first there is an excretion of very biting (*i.e.*, corrosive) bile; then shreds of the intestines follow, afterward a little blood is discharged along with the shreds, and now the affection is dysentery."

Cælius Aurelianus (400 A.D.) called dysentery rheumatism of the intestines, an error adopted by Stoll nearly four hundred years later.

Alexander of Tralles (575 A.D.) distinguished dysentery, "in which various humors are discharged by stool, from the graver variety due to ulceration of the bowels, in which shreds of the intestine are mixed with the discharges."

Other writers of antiquity, as Paulus Ægineta (660 A.D.), who made tenesmus and dysentery separate affections, Fernelius and Fabricius Hildanus, gave more or less accurate definitions of the disease and of its characteristic phenomena. Fernelius drew attention to the difference in the discharges that are found in the two varieties of dysentery, the catarrhal and the diphtheritic; in the latter form, he says, the ulcer penetrates and eats more deeply into the flesh, and the proper substance of the intestine drops out putrid or corrupted.

From this period until the revival of the study of human anatomy, in the early part of the fourteenth century, no opportunity was offered for adding any further knowledge to the rich legacy of these ancient observers. Indeed, it was not until the year 1506 that the first records of post-mortem examinations of dysenteric subjects were published in the posthumous work of Antonio Benivieni. In the writings of Hallerius (1565), Schenckius (1584), Sennertus (1626), Sydenham (1672), Bonetus (1679), and Morgagni (1762), there gradually accumulated a fund of pathological data which formed the basis for subsequent gains of positive value. Sennertus was well acquainted with the morbid anatomy, symptomatology, and treatment of the disease. He says: "Dysentery consists in frequent bloody dejections from the bowels, with pain in the abdomen and ulceration of the intestines; or it is an ulceration of the intestines with frequent bloody and purulent dejections, with pain in the abdomen and griping, arising from an acrid matter, peculiarly adverse to the intestines and eroding them." He also observed and described the difference between the sporadic and epidemic forms, and gave the indications for healing the ulcerated surface, expelling from the bowels irritating substances, and checking profuse discharges.

Following these came a host of writers, who added much to the clinical knowledge and therapeutics of dysentery by a large experience in epidemics in Europe, India, and Africa, and in armies and fleets. Among those of whom special mention should be made are: Degner (1743), Pringle (1752), Vogel and Mayer (1765), Zimmermann (1765), Stoll (1780), Rollo (1786), Hunter (1796), Desgenettes (1802), Fournier and Viday (1814), O'Brien (1822), Annesley (1828), Cruveilhier and Virchow (1842), Cambay (1847), Catteloup (1851), Dutroulau (1861), Heubner (1871), Woodward (1879), and Favrer (1881), Kartulis (in Egypt, 1885), Councilman and Lafleur (1892); Ogata (1892) and Shiga (1897) in Japan; Flexner (1890) and Strong and Musgrave (1900), in the Philippine Islands.

It is a matter for surprise to find that the ulceration in the intestine, which was considered so essential a feature of the disease by ancient observers, should have been denied by those who in the frequent study of morbid tissues had every opportunity for arriving at the truth. Pringle, in his autopsies of soldiers who had died of dysentery in Holland in 1744, observed that the mucous membrane of the intestine was black and putrid, or thickened and ulcerated, especially in the lower part of the colon and rectum; and yet Pringle, later, in consonance with the opinions of Hewson and Hunter, doubted if the intestine was ulcerated. Fournier and Viday, Chomel, Andral, and others, denied that there was ever any ulceration of the mucous membrane in acute dysentery. But Thomas, writing in 1833, of the epidemic at Tours said: "I recognized, after having made a considerable number of autopsies with the greatest care, that the ancients were right in their opinions and that the moderns are completely in error. The mucous membrane is promptly invaded by ulcerations, so numerous, so well-defined, and so constant that I claim as an undoubted fact that the ulceration of the mucous membrane is as essential a feature in dysentery as phlyctenulæ in erysipelas, le bourbillon in a furuncle, or pus in an inflammation of the cellular tissue."

Predisposing Causes. — *Geography.* — Dysentery is ubiquitous, but it is most common, most intense, and fatal in the tropics. It prevails extensively on the southern coast-line of Asia, especially in India and in the Indian archipelago, on the east and west coasts of Africa, in Guinea, in Senegambia, at the mouth of the Niger and on the adjacent islands, in Egypt, and in Algeria. In the western hemisphere it is also a formidable disease, appearing in the southern and southwestern parts of the United States, but having a graver character in Mexico, in Central America, on the west coast of South America, in the Philippines, and in the West India islands. In all these localities it is endemic, and frequently destructively epidemic, increasing its ravages in its approach to the equator, diminishing in intensity in temperate regions, and becoming infrequent above 48° north latitude. It is met with, however, in Greenland, Lapland, Kamtschatka, and Iceland, while epidemics have occurred at Esthonia, Dorpat, St. Petersburg, Jaroslav, Novgorod, in the north of Russia, and, less frequently, in the Crimea and southern Russia. It was epidemic in Norway from 1859 to 1862, and from 1853 to 1860 it produced about 2,500 deaths annually in Sweden. In 1857 there were 37,000 cases and 10,000 deaths in the same country.

The statistics of the French army illustrate the differences in the rate of mortality in temperate and tropical regions. In France the death rate among the troops from dysentery is one-twentieth of the total mortality; in Algeria it is one-fifth; in Senegal one-third. In the English army at home the disease is rare, while in India and China more soldiers die from dysentery alone than from all other diseases to which they are liable in Europe. In Ceylon twenty-three die annually from dysentery out of every thousand of effective force.

In the United States army, in the Northern Department, three die from dysentery out of an effective of one thousand men; in the middle region the proportion is one death to every one thousand, and in Florida, it is five deaths to one thousand.

According to the report of the Surgeon-General of the United States Army, for 1900, the ratio of prevalence of diarrhœal diseases among the troops was, to 1,000 effective strength, 335.05 in Cuba, 767.61 in Porto Rico, 399.60 in the Pacific Islands, and 374.19 in the United States. The differences in mortality, however, were very great. The death rate was 0.12 in Cuba, 0.35 in Porto Rico, 2.02 in the Pacific Islands, and 0.34 in the United States. During a period of ten months there were treated in the First Reserve Hospital, Manila, 1,328 cases of dysentery or 14.64 per cent. of the total cases.

In regard to the distribution among the civil population, the more temperate and colder regions do not, however, seem to have a greater immunity than the southern and southwestern parts of the country. Sporadic dysentery prevails in all parts of this country and has proved most fatal in the New England States. In the Atlantic States the greatest mortality from dysentery in 1850 was in Connecticut and Massachusetts, in 1860 in Massachusetts and Virginia, in 1870 in Vermont and Massachusetts. In 1850 the deaths from dysentery in Ohio and Indiana exceeded by far those in the Gulf States. The history of epidemic dysentery shows a wider spread in the New England States, between the years 1749 and 1798, than elsewhere, and since these years epidemics have not shown a preference for any one region.

Topography and Conditions of the Soil.—Efforts have been made to associate dysentery with special topographical or geological features, but no such association exists. Dysentery prevails in countries and in localities which differ widely in these respects. It is strange that epidemics of dysentery have been more general and more fatal in the country than in the city. This was the case in the epidemic of 1774 in France, and in the epidemics in Germany between the years 1795 and 1829. When

epidemics prevailed in the country, the disease was often sporadic in the cities.

When houses are built upon a low, damp soil, and when the soil in the immediate neighborhood of buildings, as hospitals, barracks, or prisons, is saturated with moisture, a favorable condition exists for the propagation of dysentery. Kelsch and Kiener have shown a connection between dysentery and low-lying, swampy, and ill-drained localities.

Emanations from a wet soil are probably prejudicial to health, and exert a depressing influence which is favorable to the inroads of disease. Dr. Baly, in 1842, with a view of ascertaining the cause of frequent epidemics of dysentery in Millbank Penitentiary, visited many prisons, barracks, workhouses, and lunatic asylums in England. The bowel complaints, he found, bore a close relationship to the site of the institution. They were infrequent where the building was erected on an elevation, with a dry soil and a gravelly subsoil; but very frequent if the situation was low, the soil wet from imperfect drainage, and the subsoil of peat. But dysentery does prevail in elevated and dry plateaus in India, Mexico, and Peru.

A soil saturated with dysenteric excreta is a fruitful source of the disease. This is shown in the fact, mentioned by Czernicki, of the breaking out of dysentery in two French squadrons which in 1875 occupied ground where a cavalry regiment affected with dysentery had previously camped. A similar occurrence was noted at Châlons in 1890.

Overcrowding and Imperfect Ventilation.—The overcrowding of human beings in badly ventilated buildings or ships is often followed by outbreaks of dysentery. It was not rare for a slave-ship, in making the transit from Africa to America, to lose three-fourths of her living cargo from this cause. In prisons, reformatories, etc., before attention was paid to such matters, epidemics of dysentery were frequent and destructive. This was due in part to the deterioration of health from imperfect ventilation, and in part to the accumulation and improper disposal of fæcal matter.

Season and Temperature.—In all climates dysentery is most prevalent in the hot season. In the United States August is the month of its greatest mortality, and in the summer and early autumn the largest number of cases occur. This is true of sporadic as well as of epidemic dysentery. Hirsch has collated the histories of 546 epidemics, of which 404 were in the summer and autumn, 113 in the autumn and winter, 16 in the spring and summer, and 13 in the winter. Figures given by Kelsch and Kiener show the same preponderance in summer and autumn. The minimum mortality in this country is in January and February.

Elevation of temperature conduces to the origin and spread of dysentery. Unusual heat preceded the epidemic of 1813 in Holland, of 1834 to 1836 in France, Switzerland, Belgium, and Germany, of 1853 in Sweden, and of 1859 in France. In the Franco-Prussian War of 1870, in the wars of Italy and the Crimea, and in the civil war of 1861–65 in the United States, the relationship between extreme heat and dysentery has been shown; but the fact that campaigns are chiefly conducted during the summer adds the effects of other causes to heat influence. That there is no necessary relationship between dysentery and extreme heat is shown by the rarity of the disease in the cities of the Atlantic seaboard in seasons of long-continued high temperature. Epidemics have appeared in cold weather in Russia, Sweden, and Canada. In Ireland an epidemic lasted from autumn until spring, and in 1732 there was an epidemic in Siberia in January. Of 13,900 cases in Bengal there were 2,400 in the cool season, 4,000 during the warm and dry season, and 7,000 in the period of warmth and moisture. In warm climates endemic dysentery lasts throughout the whole year. Dutrouleau says of 100 deaths from dysentery in Martinique 18.76 took place from January to March, 20.55 from April to June, 27.73 from July to September, and 32.96 from October to December.

Atmospheric Moisture.—The saturation of the air with moisture is recognized as offering another favorable condition for the spread of dysentery. Heat and moisture combined enfeeble the individual, and favor putrefactive decomposition in animal and vegetable matters, and hence assist materially in the propagation of disease. Moisture alone is not an essential factor, however, as out of 119 epidemics 62 were preceded by moist, and 57 by dry weather.

When cold and atmospheric moisture are combined the effect upon the individual is the same, and dysentery may result. Thus, Pringle states that at the battle of Dettingen, the French army was exposed to an abundant rain, and the soldiers spent the night in their wet clothing. A large number were attacked with dysentery, while a corps stationed at some distance, and not thus exposed, escaped illness.

Vicissitudes of Temperature.—The season of dysentery has been said to be when cooler nights succeed hot days, and when sudden changes of weather occur. In tropical countries oscillations of temperature, after periods of prolonged heat, often precede epidemics, and the same thing has been noted in temperate climates. Pruner in Egypt, Lame in Guiana, McMullin in the Barbadoes, Ruthay in China, and Lavacher among the negroes at Santa Lucia, have noted the appearance or aggravation of dysentery after sudden and marked temperature variations. In armies on the battlefield or in exposed camps, dysentery follows unusually cold nights or sudden changes in temperature, the officers always suffering less, however, as they are better clothed and better protected against such influences. It is not now thought, however, that variations of temperature have much influence in causing outbreaks of dysentery, although formerly this was a prevailing belief.

Impure Water Supply.—From the earliest times bad drinking-water has been believed to be a potent cause in originating dysentery. But no part of the study of the etiology of the disease gives a better idea of the contradictory nature of the evidence than that upon which a belief or disbelief in the evil influence of impure drinking-water is based. Read in 1770 noted that, in an epidemic at Metz, a regiment occupying a certain caserne had ninety-one cases of dysentery, while other regiments suffered much less. The soldiers of this regiment used water contaminated by sewage from neighboring privies, and the closure of the infected wells was followed by a diminution in the number of cases. This is an early observation which is the counterpart of an innumerable number of the same sort. Cases and epidemics have been traced to the use of water contaminated with sewage, with animal excrement, and with matters from animal and vegetable decomposition. The cutting off of the supply from the contaminated source has frequently not prevented outbreaks of dysentery, nor stopped the spread of it. The use of rain water in ships at infected foreign ports is not a preventive, nor do the Chinese escape who, according to Dudgeon, invariably use boiled water. In the Millbank penitentiary three hundred and fifty prisoners were given pure water from an artesian well, while seven hundred drank Thames water, but intestinal diseases were as common in the one class as in the other. On the other hand, an epidemic of dysentery began on the Pacific Mail steamer *Alaska*, and several of the crew were attacked eight or ten days after the tanks were filled at Hong-Kong. The water in the tanks was found to be filled with bacteria; the crew was put on condensed water and the further spread of the disease stopped. Davis mentions that at Tortola, in the West Indies, the inhabitants use rain water only, and while they escape, the ship's crews are invariably attacked with dysentery. So well known is this that the residents, when invited to dinner on board a man-of-war, frequently carry their own supply of drinking-water with them.

Other observers mention facts which are in direct opposition to these. In 1848, two French ships-of-war, the *Brandon* and the *Embuscade*, visited St. Pierre. A violent epidemic of dysentery attacked the crews, who used distilled water, or water brought from France. The

merchant ships in port, which took no such precautions, escaped the disease.

The workmen engaged in the Suez Canal had a greater immunity from dysentery after 1863, when the purer water of the Nile was obtained. Lalluyaux d'Ormay demonstrated at The-dau-Not, in Cochin China, that dysentery could be produced or arrested at will by using or not using certain waters. In China the water of certain rivers is notoriously dangerous to health, and produces dysentery. Thévenat, in his work on "Diseases of Europeans in Warm Climates," says nothing is so prone to lead to disorganization of the large intestine as infected water. The cause of contradictory evidence is now easily understood. Impure water *per se* cannot produce dysentery; the water must contain the infecting micro-organism as one of its impurities.

Improper Food Supply and Indigestion.—The occurrence of dysentery has long been associated with errors in diet, and with indigestion and food decomposition in the intestinal canal. Acute indigestion, after taking food in excess, or when it is unfit for use, may lead to diarrhœa or dysentery. The acrid matters, which were dwelt upon by the Greeks as causes of dysentery, arise from the putrefactive changes in the intestinal contents, and are, without doubt, agents in exciting inflammation and in predisposing to dysenteric infection.

Individual Predisposition.—Age.—No age is exempt from dysentery. It is asserted by Zimmermann that infants whose mothers have dysentery are born with it. Young children, in the hot season in temperate climates, are prone to it, but not to the same extent as to diarrhœa. Recruits from nineteen to twenty-one years of age, newly arrived in India and Algeria, are more liable to contract the disease than older soldiers. In the French navy the same predisposition has been noticed among the young apprentices. In the old, dysentery is a common and fatal affection.

Sex.—Dysentery is more prevalent among males than among females.

Race.—All races and nations are subject to sporadic if not to epidemic dysentery. The natives as well as foreigners are attacked by it, and its fatality is usually greater among the native population. In this country the opportunity is given to contrast the disease as it affects the white and black races. Campbell, of Georgia, has described an epidemic which involved the whites only, but this is an isolated observation. In an epidemic in Byhalia, Miss., in 1883, both the masters and servants succumbed to dysenteric symptoms; in a radius of ten miles, out of 100 deaths, 85 were from this cause.

A race out of its own habitat is a greater prey to dysentery, owing to the adoption of a mode of life and diet which are unsuited to the necessities of the climate.

Condition and Habits of Life.—Dysentery is more fatal among the poor than among the rich, and it is especially fatal among the poorly clothed and badly fed. Overfatigue, loss of sleep, and anxiety favor the onset of the disease. Indulgence to excess in alcoholic liquors is thought to be a cause in hot climates, but as errors of diet, exposure, fatigue, and a general disregard of the rules of health accompany alcoholic indulgence it is probable that alcohol alone is not an active cause.

Influence of Other Diseases.—The relation of scurvy to dysentery has been much dwelt upon. During the civil war in this country the concurrence of diarrhœa, dysentery, and scurvy was frequently noted. All followed prolonged deprivation of vegetable food, the hardships of camp life or exposure in the field, but that there is no causal relation between scurvy and dysentery is abundantly proved by experience everywhere. Of fifty cases of scurvy admitted into the European General Hospital, Bombay, in 1863, only one had dysentery.

In epidemics of cholera, a transition of the choleraic into dysenteric symptoms has sometimes occurred, and in fatal cases of cholera lesions similar to those characteristic of dysentery have been found.

A very general belief has prevailed as to the close association of malaria and dysentery. In the Southern and Southwestern States the coincidence of "bilious" fever and dysentery, the two diseases frequently appearing in the same individual, and arising apparently under the same conditions, led to the opinion that both diseases are due to one and the same poison, developed in the decomposition of vegetable matters. But the geographical history of dysentery shows that conditions leading to malarial disease are by no means necessary to originate dysentery. Dysentery and malaria prevail independently of each other when there are the same conditions of season, soil, and climate. An epidemic of dysentery occurred in San Joaquin Valley, Cal., in May, June, and July. Malarial fever prevailed in August, September, and October of the same year. In Trenton and Gibson Counties, Tenn., in the autumn of 1881, a maximum of dysentery was reached while there was but little malarial disease. In 1874 and 1875, when intermittent fevers were so rife that there were not well persons enough to care for the sick, there was scarcely one case of dysentery.

The discovery of the malarial parasite and the belief in the parasitic origin of dysentery have done away entirely with this once common opinion. Such coincidences of malarial fever and dysentery or of dysentery and typhoid or other specific fevers are examples of double infection.

Dysentery complicates various acute and chronic disorders, and these, with former attacks of dysentery, and all previous states of ill-health, may be regarded as predisposing to its development.

Constipation has been thought to bring about dysentery, the hardened fæcal masses acting as foreign bodies in the colon and rectum. Cullen held that the griping, frequent stools, and tenesmus were caused by their presence.

Forms of Dysentery.—The term dysentery is now known to include several diseases unlike in their etiology and pathological anatomy, occurring under different conditions of climate and locality, although resembling each other to some extent in their symptoms. For convenience they are spoken of as forms of dysentery, although their differences are great enough to deserve separate classification.

The classification most usually adopted of sporadic, tropical or endemic, and epidemic or diphtheritic dysentery was based upon clinical and pathological differences, but our present knowledge shows that the differences between these forms are not great enough to justify this distinction. The study of the etiology of the disease has now advanced so far that we are justified in stating that there are several, perhaps many forms of so-called dysentery, each due to infection by some specific micro-organism. It is not certain, however, that any one variety is limited geographically, nor what the relation may be between the dysenteries of different climates and countries. So far, the only forms that are definitely placed are the dysentery due to the Amœba coli and that due to the Bacillus dysenteriæ. It seems probable that in time etiological research will lead to the entire abandonment of the term dysentery.

Sporadic dysentery or the dysentery of temperate climates is described separately on account of its clinical features.

I. Acute Catarrhal or Sporadic Dysentery.

Etiology.—Nothing is definitely known as to the bacteriology of catarrhal dysentery. Without doubt it has a specific cause, probably a bacillus which has so far eluded discovery. Etiologically it may be the same as the bacillary dysentery of Manila; the disease cannot arise from chemical or mechanical causes.

Pathological Anatomy.—The mucous membrane of the rectum and lower bowel is inflamed. In the milder forms there is no change beyond a more or less intense hyperæmia of the mucous membrane over areas of varying extent. Punctiform hemorrhages are seen in the mucosa or submucosa. The mucous coat is swollen and covered

with much mucus, pus, and red blood cells. The surface epithelium is absent, and the exfoliation of epithelium may involve the glands. There is sometimes destruction of the tissue of the mucous membrane; shallow ulcers are seen, formed by extension of the superficial softening. Sometimes the ulcers extend to the muscular coat. In the submucosa, which is much thickened, there are masses of granulation and pus cells, and the connective-tissue cells are enormously swollen. The solitary follicles are swollen and from distention they burst, thus forming an ulcer.

Symptoms.—In the milder forms of the dysentery of temperate climates the attack may begin with diarrhœa and with premonitory distress in the abdomen and tympanites. Colicky pains follow; the evacuations very soon, sometimes at once, are characteristic of dysentery; they are small, contain or consist wholly of mucus, and are stained with blood. The griping pains, as the attack advances, recur at short intervals in the region of the umbilicus, in the line of the ascending and descending colon, extending to the left iliac fossa. The urgent desire to empty the bowel follows each paroxysm of pain, and with great straining (tenesmus) a small muco-sanguinolent mass is expelled. The patient continues his unrelieved expulsive efforts and complains of burning in the anus. In cases of this kind there may be very little fever or none at all, but the degree of weakness is out of proportion to the mildness of the attack. The patient improves gradually after a few days and is well at the end of a week or ten days.

In severer forms, lasting ten, fourteen, or twenty-one days, these same symptoms are intensified, especially the constitutional symptoms; the pulse is more frequent and feeble, and the temperature ranges from 101° F. to 103° F. The strength undergoes a more rapid reduction, the effect of the violent and frequent abdominal pains and the frequent mucous and bloody stools, which are attended with great straining, and with the sensation as if a foreign body were in the rectum. In the beginning the discharges are composed of a viscid mucus floating in a serous liquid. On the second or third day blood is mixed with the mucus, and there is less fluid. After the fifth or sixth day blood is passed with muco-purulent or purulent fluid, the source of which is the ulcerating mucous membrane. Gradually the stools become more abundant, and consist of a dirty white or grayish fluid, of a slightly fœtid odor. Their number varies from twenty to forty in the twenty-four hours, being more frequent at night, but there is no limit, as many as two hundred having been noted.

The progress of the attack is attended with fever, with thirst, sometimes with delirium at night, always with restlessness and insomnia; the abdominal pains are so severe as to excite cries, and the prolonged expulsive efforts cause great exhaustion and profuse sweating. Vesical tenesmus accompanies rectal tenesmus, and prolapse of the bowel is not infrequent, especially in children. A sensation of oppression in the epigastrium and vomiting are due to reflex influences.

The loss of strength is rapid, the pulse grows feeble, and the patient lies on one side with the knees drawn up. If recovery is to be the result there will be a diminution in the number of the stools and a return of fæcal matter. Death is preceded by offensive fluid movements. Such attacks may pass into the chronic form.

II. Dysentery Due to (1) the Amœba Dysenteriæ and to (2) the Bacillus Dysenteriæ.

Etiology.—Amœbæ were first seen by Lambl in the intestinal contents in 1859. In 1875 Lösch, in examining microscopically the stools of a patient, twenty-four years of age, who was suffering with an ulcerative affection of the large intestine, discovered an amœba which appeared in great numbers; this he called "amibe du colon" or amœba coli. Next he injected these stools into the intestines of two dogs, one of which had vomiting and diarrhœa. The animals were then killed, the intestines were found to be inflamed, were covered with bloody mucus, and showed many ulcerations. The amœbæ were found in the mucous membrane and in the ulcers. The parasite appeared as a protoplasmic mass and measured on an average 20 to 50 μ; in motion and with their greatest elongation they reached over 60 μ. Their protoplasm was very granular and enclosed six or eight round vacuoles.

Koch, in 1883, found the amœba in the intestines of those dying from Egyptian dysentery. Kartulis in 1885 attempted to prove that the amœbæ played the principal rôle in the pathogenesis of dysentery. He also found them in other ulcerative affections of the intestine, viz., in typhoid fever and in tuberculosis. In certain complications of dysentery, and especially in abscess of the liver, Kartulis found the amœbæ in the pus, associated nearly always with the ordinary microbes of suppuration. Osler, first in America, reported a case of abscess of the liver which developed in the course of dysentery and in which he found the amœbæ in large numbers. Much that we know of this form of dysentery is due to the work done in Johns Hopkins Hospital by Osler, Councilman, and Lafleur, and we are indebted chiefly to the paper of Councilman (Transactions of the American Association of Physicians, 1892) for our knowledge of the pathological anatomy of amœbic dysentery. Dock afterward demonstrated the amœbæ in a case of dysentery contracted in Texas. Vassi has since found them in a case of abscess of the liver; he found only a small number in the pus, but they were present in great numbers on the side of the abscess, also in some of the small branches of the portal vein.

These observations seemed at one time to have definitely fixed the amœba as the one infecting micro-organism in tropical dysentery, and the name "amœbic dysentery" took firm root in medical literature.

The fact that amœbæ are found in other diseases, as in cholera and typhoid fever, and in the intestines of healthy persons, threw doubt upon the theory that this was the infecting micro-organism of dysentery. The inference is, that there are intestinal amœbæ which are harmless or which at any rate do not produce dysentery. These have been injected without effect into the rectum of cats. On the other hand, Strong and Musgrave assert that they have had no difficulty in producing dysentery with ulceration of the large bowel by injecting stools or contents of liver abscesses containing mobile amœbæ dysenteriæ. Councilman and Lafleur believed that there were a number of species of amœbæ which may inhabit the colon.

From recent experience in Manila, as well as from previous studies, it may be concluded that there is an amœbic dysentery. As amœbæ, however, were not found in all cases of dysentery, either in the stools or in the intestinal tissues after death, doubt was raised as to whether the amœba was the only cause of dysentery.

Bacilli were found in the stools of dysentery, and in the glands or walls of the large intestines, by Klebs (1887), Ziegler (1892), Chante-Messe and Widal (1888), Grogorieff (1892), Laveran (1893), and Arnaud (1894).

Celli and Fiocca (1895), studied 62 cases of dysentery and concluded that the amœba coli is not the cause of this disease. They found a colon bacillus, called by them B. coli dysenteriæ, having special virulence, which they considered responsible for the lesions in all cases. With this bacillus they caused dysentery in cats, and a toxin separated from it produced the same results. Celli in the next year reported that he invariably succeeded in isolating B. coli dysenteriæ from dysenteric cases.

In epidemic dysentery in Japan Ogata (1892) found no amœbæ but he isolated fine bacilli which, when introduced by the mouth or rectum, caused intestinal ulceration in cats. More recent observations were made by Shiga in Japan during an epidemic in 1897 when 22,300 deaths, 24 per cent., occurred out of 89,400 cases. A bacillus was isolated that fulfilled all the requirements to give it the place of causative agent. It was found in the intestinal contents and walls and in the mesenteric glands in 36 cases.