

tion, or on cloths, which are then burned. Soiled bed or body linen should be at once removed and disinfected before the secretions are permitted to dry upon them. When this is not practicable the soiled areas may be wet with strong disinfectant solution. The floor should be frequently mopped with a strong disinfectant solution; and the hanging of a damp sheet over the door leading into the room is of advantage. Eating utensils should be scalded after use and all uneaten remnants of food at once burned. On the part of the attendants great care should be taken to disinfect the hands after each manipulation of the patient. While attending to the patient a cotton mask, suspended so as to shield the nose and mouth and moistened with some antiseptic solution, may be worn to prevent possible in-

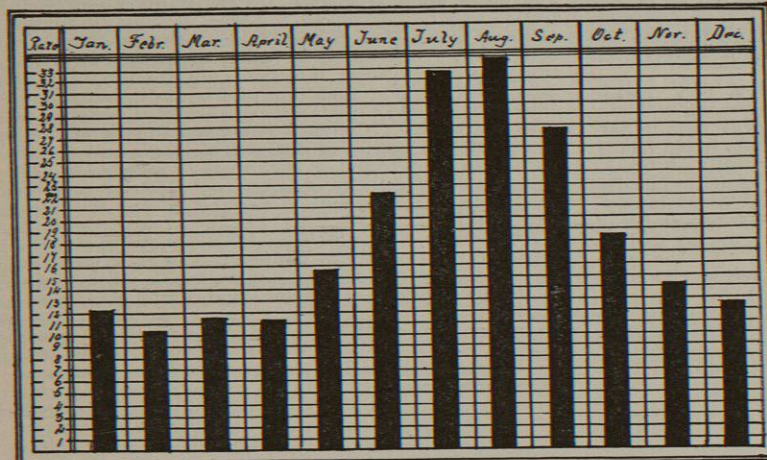


FIG. 1080.—Distribution, by Months, of Cases of Diarrhoeal Disease, per Thousand Strength, Occurring in the United States Army during the Decade 1875-84.

fection from ejected mucus or membrane. Careful disinfection of the room and its contents is, of course, required after removal of the patient.

Protective Inoculation.—In preventing the occurrence of diphtheria in those exposed to infection the most important prophylactic measure is that through which a condition of immunity is conferred by the subcutaneous injection of blood serum from an animal rendered highly immune to this disease. As the immunity thus produced is not permanent, lasting only from four to six weeks, the procedure should be employed only in the case of soldiers who have been presumably exposed to infection, or for the protection of such hospital corps men as are about to assume charge of diphtheria patients.

For immunization of those exposed to the infection of diphtheria an injection of 400 to 500 antitoxic units is usually sufficient.

DIARRHOEA AND DIARRHOEAL DISEASE.—Diarrhoea is ordinarily to be regarded not as an essential disease, but as symptomatic of an effort on the part of a healthy bowel to relieve itself of irritating contents or of some morbid internal condition. In the military service, however, the affection frequently prevails among a large number of persons at the same time and place, and by its severity, its tendency to become chronic, its refractability to treatment, and its undoubtedly infectious character, it may, under such conditions, be safely regarded as a distinct disease. Figures showing the prevalence of this specific affection are not available for our service, owing to the classification of all diarrhoeas, whether symptomatic or essential, under the same heading. Further, in the medical reports of our army, conditions of

this character, together with dysentery, are classed together as diarrhoeal disease, and hence must be largely considered together. Under this heading they brought more men on sick report during the decade 1887-96 than any other class of diseases, the rate per thousand strength being 107.09. Field service largely favors their occurrence, and in nearly all wars they have been the most common class of affections. For the year of peace, 1897, in our army, the admission rate for all diarrhoeal diseases was 73.77 and the death rate zero; while during the year of war, 1898, the admission rate was 303.76 and the death rate 2.14. These diseases are much more prevalent in hot climates than in the temperate zone, the admissions and deaths for troops in the United States alone, during the year 1898, being respectively 247.39 and 1.39 per thousand strength; while for those soldiers serving in the tropical islands the admissions were 551.54 per thousand, and the deaths 5.44.

For diarrhoea alone the average annual rate of admission, during the Civil War, was 608.84 per thousand strength; while the deaths from this cause averaged 13.70 per thousand. For the period 1868-84 the admissions for diarrhoea had fallen to 230.45, and the deaths to .26, per thousand strength. For the decade 1885-94 the admission rate was 109.65, and the death rate .02. For the year 1897 the admissions per thousand amounted to but 68.65, there being no deaths. For the year 1898, during the war with Spain, the admission rate rose to 274.49, but the death rate amounted to only .27 per thousand strength.

Diarrhoeal diseases, in the temperate zone, are much more prevalent during hot weather, as is well shown by the accompanying diagram. Race is a matter of no small importance. While our colored troops are particularly susceptible to infection by dysentery, this is not

the case with regard to simple diarrhoea, to which they appear to present considerable immunity. For the decade of peace, 1886-95, the admissions per thousand of white troops, for all diarrhoeal diseases, amounted to 115.68; while for the colored troops during the same period the rate was 99.75. During the year 1897 the rates of admission were 75.78 for white troops and 52.22 for colored soldiers. During the war with Spain a proportionally much greater number of negro soldiers saw hard service than did those of the white troops, yet the admissions for the former were only 187.20 per thousand strength, while they amounted to 312.72 per thousand for the latter. Age exerts a marked influence on the occurrence of diarrhoeal diseases; the rates for our service, at various periods of life, for the seven years 1890-96, being as follows:

Age.	Admissions per 1,000 of each class.
19 years and under	202.43
20 to 24	134.19
25 to 29	98.70
30 to 34	82
35 to 39	79
40 to 44	80.96
45 to 49	75.68

For the same seven-year period the admission rates for all diarrhoeal diseases, per thousand strength, were thus divided among various branches of the service:

Artillery	133.35
Cavalry	113.29
Infantry	96.84
Medical Department	34.96

Diarrhoeal diseases are much less frequent among officers than among soldiers.

As stated above, in many instances diarrhoea is undoubtedly infectious and capable of transmission to others by means of the excreta. No special micro-organism has been shown to stand alone in a causative relationship to the disease, and the latter may undoubtedly be produced by several forms of bacterial life. Diarrhoea prevails most in damp soils, especially when contaminated with organic matter. The diarrhoea prevalence and death rate are notoriously greatest among those whose resistive powers are impaired by malnutrition, exposure and fatigue. As with dysentery, chilling and sudden changes of temperature favor it. Foul air favors it, and want of ventilation and light are conducive to a high mortality. Density of population, as a factor in soil pollution, especially in camps, markedly increases the prevalence of diarrhoea. Food is closely concerned with the epidemic prevalence of diarrhoea, not only by predisposing toward it by causing digestive disorders, but also through its contamination with infectious material capable of directly provoking the disease. Bad water undoubtedly plays a prominent part in its causation, but probably not to the extent supposed by some. The cause of epidemic diarrhoea is undoubtedly transmissible by means of flies, and there is considerable evidence to show that air currents may be the means of its dissemination.

A distinction should be made between the epidemic diarrhoea indicated by the foregoing and those outbreaks of diarrhoea which not rarely occur among troops who have partaken of food in which certain putrefactive changes have occurred. In these cases the causative agent is usually a chemical substance, and the diarrhoeal symptoms produced are merely those due to its properties as an irritant poison.

Prophylaxis.—The prevention of epidemic diarrhoea in the field depends upon the proper location of the camp, the absence of organic pollution of the soil, a pure water supply, the careful selection, preparation and storage of food, and the prompt disinfection of all excretal discharges.

While mild cases, in garrison, may probably be safely treated in quarters under most circumstances, in the field, where their infectious nature is suspected, such cases should preferably be removed to hospital for treatment; particularly since cases of diarrhoea may merely represent the early stages of infection with dysentery, typhoid fever, or even cholera. From the many causes through which diarrhoea may be produced, it is evident that no general rule can be laid down to cover all contingencies, but each case must be acted on independently, according to its merits, by medical officers.

DYSENTERY.—Occurrence.—Of all the diseases to which troops are subject on active service, especially in hot climates, dysentery is one of the most formidable and important; and this almost equally on account of its frequency, its severity, the difficulty of its treatment and its proportionately high mortality. The disease is one which is peculiarly favored by camp life.

History gives many instances in which dysentery has become epidemic among troops. It made frightful ravages in the army of Xerxes, in 480 B.C.; and it is recorded that in the invasion of Italy by Theodebert, in the year 538, one-third of his force died of this disease, compelling retreat. The army of Henry IV. was reduced three-fourths of its effective strength before the battle of Agincourt, through an epidemic of this disease. In 1773, half the English army at Hanau had dysentery, which decreased on the abandonment of the camp; and the same occurred in 1778 in the army of Prince William of Hesse. In 1757 the French army introduced an epidemic of this disease among the civil population of Mayence. In 1793 it ravaged the French army in Italy, and in 1812 in Poland. In Egypt, Napoleon lost more men from dysentery than from the plague. It prevailed largely during the Crimean War; and Laveran states that in three months there were treated, in the hospitals at Constantinople, 9,919 cases of diarrhoeal disease—chiefly dysentery—of

which 15 per cent. proved fatal. At Metz, in 1870, it was one of the greatest causes of mortality in the besieged army. In the military operations in our own country, it prevailed in the French war of 1756, and during the Revolution it became epidemic in the trenches before Boston. It was most extensive and fatal during the Seminole War in 1836; and the same was the case during the war with Mexico. During the Civil War period, July, 1861, to June 30th, 1866, the average rate of admission for dysentery, per thousand strength, was 120.88; the death rate for the same cause and period was 3.67. While the admission rate varied but little during these years, the mortality steadily increased; the death rate per thousand strength for this cause being 1.64 in 1861-62 and 6.31 in 1865-66. Since the Civil War, its prevalence in our country is shown by the following figures:

Period.	Admissions per 1,000 strength.	Deaths per 1,000 strength.
1868-84	29.04	0.59
1885-94	6.52	.10
1895-98	12.05	.38
1898-98	19.91	.45
Year 1897	2.39	...
Year 1898	28.39	1.86

The rates for dysentery in foreign armies in the present times of peace, like those until recently obtaining in our own service, are low. Among the British troops stationed in the United Kingdom during the decade 1888-97, the admissions per thousand strength amounted to .5, the deaths to .2. For the year 1898 the admissions amounted to .7, the deaths to .03. The occurrence of dysentery in the German army is shown by the following rates:

Period.	Admissions per 1,000 strength.
1881-82 to 1885-86	1.4
1886-87 to 1890-91	.24
1891-92 to 1895-96	.31
Year 1894-95	.25
Year 1895-96	.57
Year 1896-97	.10

The milder cases are not taken into hospital and do not figure in the above rates for the German army.

In the Austrian and Russian armies the rates of admission, per thousand strength, have been as follows:

Year.	Austrian Army.	Russian Army.
1892	4.1	3.4
1893	1.3	2.1
1894	1.3	2.0
1895	1.2	2.3
1896	.8	1.6
1897	.6	1.7

The case mortality among the Russian and Austrian armies during the above period was twice as high as in our own military service or those of England and Germany.

Nothing more clearly shows the value of modern military hygiene and sanitation than the great and progressive reduction of the rates for dysentery, which has occurred in all armies in the last two-score years. Not only has the proportion of admissions been largely decreased, but the case mortality has been reduced to an even greater degree. In our own army the vast improvement—as well as the favoring influence of field service on the occurrence of this disease—is shown in the chart (see Fig. 1081). For the French army in Algeria it is stated by Coustan that in 1847-48, out of every 1,000 deaths from all causes, 403 were from diarrhoea and dysentery, chiefly the latter, while for the period 1867-78 this disease occasioned but 72 deaths out of each 1,000; and the rate has fallen progressively since that time.

Predisposing Causes.—Dysentery occurs both endemically and epidemically in all climates, but is especially

prevalent in the tropics. For the decade 1888-97 the admissions for this disease, among British soldiers in India, China, the Straits Settlements, Ceylon, West Indies, Egypt and Cyprus, and Mauritius, amounted to an average of 15.17 per thousand for all; while for the United Kingdom they were but .5, and for Canada .1 per thousand. In our own army, for the fourteen months, May, 1898, to June, 1899, inclusive, the death rate from diarrhoea and dysentery is given as 1.3 per thousand of troops serving in the United States; 5.69 for those serving in Cuba; 2.08 for those in Porto Rico, and 2.48 for those stationed in the Pacific Islands. For the last six months of 1897 the admissions for dysentery in the Spanish army in Cuba amounted to 72 per thousand strength, and the death rate to 10 per thousand strength. In temperate climates, summer is the season when the disease, like all diarrhoeal diseases, prevails to the greatest extent; in the tropics it occurs most frequently at the close of the rainy season. Few facts in connection with the relation be-

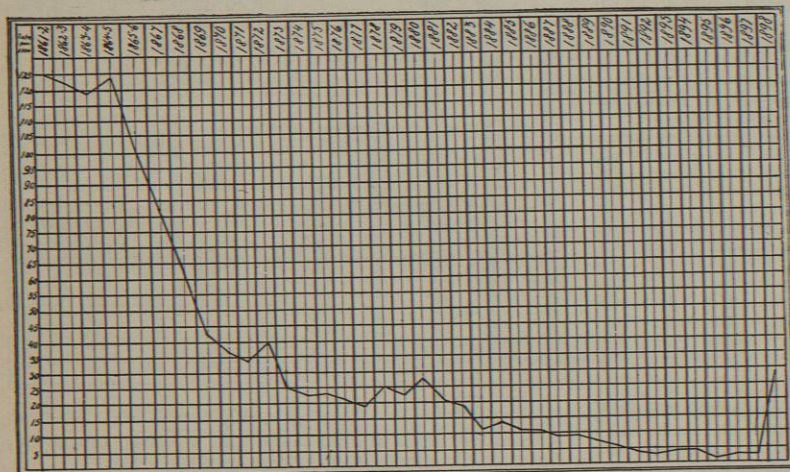


FIG. 1081.—Admissions for Dysentery in the United States Army, per Thousand Strength, for the Period 1861-98, Excluding the Year 1867.

tween dysentery and climate or season are more clear than those which indicate the influence of vicissitudes of temperature, and exposure to chilling, in determining attacks. The reduction of dysentery which has occurred in the French army has been thought to be largely due to the provision of conveniences which render unnecessary the chilling of the soldiers at night while attending to the calls of nature.

Dysentery, though sometimes occurring in dry localities, manifests a decided preference for damp and water-logged soils. Of great importance in its epidemic occurrence is the saturation of the camp site with organic, and particularly faecal, material. The destructive epidemics of former times undoubtedly depended largely upon long occupancy of camp sites, resulting in fouling of both soil and water. All caecetic states of the constitution powerfully predispose to dysentery. Scurvy and malaria are no exceptions to this rule, and the latter gives rise to a form of the disease peculiarly resistant to treatment. Fatigue, exposure, hardship, and anxiety also appear to have no small influence in determining its occurrence. A faulty dietary, especially as found in insufficient, coarse, or improperly cooked food, green or over-ripe fruits, an excess of salt meats, or the over-use of alcoholics, notoriously favors the disease. These points were particularly well shown in the happy change in the condition of the British army at the Crimea, in respect to dysentery, as soon as its wants as to diet, shelter and

clothing were properly satisfied. A large number of outbreaks of dysentery have occurred during the prevalence of typhoid fever, the development of both diseases apparently being favored by the same general conditions.

Dysentery is particularly liable to affect young soldiers through their disregard of matters of hygiene and probably greater individual susceptibility. Tripler states that during the war with Mexico the death rate from dysentery was twice as high in the newly raised troops as in the old army. Negro troops appear particularly liable to contract dysentery. In our own service, for the decade 1879-88, the rates per thousand strength were as follows:

	Admissions.	Deaths.
White troops.....	13.65	0.20
Colored troops.....	29.65	.32

Among the British troops stationed in the West Indies, for the decade 1888-97, the rates for European troops, per thousand strength, were 6.9 for admissions, and .33 for deaths. For the same period the rates for non-European (negro) troops were respectively 16.8 and .44. Coustan, on the other hand, notes an immunity to this disease among the natives of Northern Africa, citing an instance where "a French column in Algeria suffered severely, while the native Arab followers, who set every law of hygiene at defiance, escaped sickness." From the greater care which they are able to give themselves, and also owing to their greater attention to sanitary detail, officers are much less liable to dysentery than are enlisted men.

Method of Infection.—The commonest recognized portal of infection is the mouth; the specific exciting cause of the disease gaining entrance in contaminated water or on uncooked foods on which the organism is located. Experiments show that infection can occur through the rectum, but this is undoubtedly a rare mode in human beings. The instances in which outbreaks of dysentery have been traced to the use of foul water, particularly that contaminated with faecal matter, are very numerous; and of all causes contributing to the occurrence of this disease, that of impure water is the most important. In most instances this fluid merely serves as a vehicle for the introduction of the specific cause into the system, but it may at times, through suspended particles, have a predisposing influence through its irritative action on the bowel.

Prieur has reported an epidemic of 315 cases of dysentery occurring in 1891 in a small garrison in the French army, which he regards as directly traceable to the use of the common latrine by the first patient, who, as the affection became more advanced, was unable to keep from voiding his discharges on the floor and seats. No case appeared until six days after the first case was well developed. He believes that the affection was directly due to the dysenteric discharges being mixed with the dirt on the floor of the latrine and being carried into barracks on the shoes of the soldiers. The food of the latter was then contaminated with this infectious material; a result rendered very possible by the absence of mess rooms in French barracks and the fact that the soldier of that service usually sits on stairways or on the floors of halls or barrack rooms while eating his food.

Prophylaxis.—This is naturally dependent on the etiology. All drinking-water should be protected from contamination, and, when open to the slightest suspicion, should be sterilized by heat. It is well to keep in mind

that if pure water be not provided in a hot climate, the men will get it from any source, however impure. Food should be carefully watched in respect to its sufficiency, quality, and the thoroughness of its cooking. When an epidemic of the disease threatens, all raw fruits and vegetables should be excluded from the diet; and, if possible, hard bread and beans also, since these are difficult of digestion and irritating to the intestinal canal. Chilling, especially of the abdomen, should be avoided, and the use of the flannel band may be advisable. The camp site should be dry and well drained. If the disease appears with any severity the camp should be promptly moved without waiting for further developments. Instances have been known where regiments were affected with dysentery every time they encamped on a certain space, and old camping grounds notoriously favor the occurrence of this disease. The camp should be carefully policed to limit the fly plague, and the contents of latrines disinfected and covered twice daily. If possible, the excreta should be burned. Great care should be taken to prevent contamination of the water supply with faecal matter, either from the location of the latrines or from uncleanly habits on the part of troops. Dysentery patients should preferably be removed from the locality in which the disease was contracted. Inasmuch as dysentery occasionally spreads in military hospitals where large numbers of such cases are under treatment, the necessity of free ventilation, abundant air space, and the prompt disinfection of the stools, bed pans, commodes and enema tubes are matters of the first importance.

EPIDEMIC INFLUENZA.—Occurrence.—In the military service, influenza is chiefly of importance through the incapacity for duty which it produces. The military age does not include the extremes of life, at which the disease is most fatal, and hence the mortality directly resulting from this affection is small. That it exerts an unfavorable influence in the production of secondary pneumonia and tuberculosis, however, there can be no doubt, though this is not shown by statistics. The disease in our army has occurred in well-defined epidemics of great intensity but short duration. During recent years these epidemics have occurred with much greater frequency. Following their subsidence there appears to have been a tendency on the part of medical officers to confound simple respiratory catarrhs with this disease, even in the absence of any epidemic tendencies, thus probably unduly raising the rates for this affection. During the Civil War the admission rates for influenza, per thousand strength, amounted to 60.84. For sixteen years, 1868-84, the cases fell to an average of 9.39 per thousand strength. During the decade 1885-94, epidemics in 1892 and 1893 greatly raised the figures for this disease, making the admissions 49.88 per thousand strength. For the period 1895-98 the admission rate was 44.92. For the year 1897 the admissions were again increased to 74.35; while for 1898 they fell to 32.37. In foreign armies the disease has prevailed among troops during the widespread epidemics which have from time to time occurred. In 1892 and 1893 high rates for this disease were given in all European armies. In the English army the disease has prevailed nearly every year since 1889. In the Russian army influenza appears annually as a potent factor in elevating the sick rates.

Dissemination and Infection.—The powers of resistance of the specific organism appear to be of a very low order. Pfeiffer found that dried cultures of influenza bacilli kept at the ordinary temperature were usually dead in twenty hours, and that no growth could be obtained from influenza sputum at the end of two days. Their duration of life in ordinary water is also short, death usually occurring in two days. From these experiments, Pfeiffer concludes that outside the body the bacilli cannot multiply under ordinary conditions and can remain alive but a short time only. The mode of infection in the disease he accordingly considers to be chiefly by direct contact with infective mucus, with which the bacilli probably alone escape from the organism. Its rapid spread over large areas was long thought

to be explainable on the supposition that the infection was air-borne, but this is probably due to the combined effect of a short incubation period, an early infectiveness, a widespread susceptibility, and the existence of early unrecognized cases. It is impossible to say what are the conditions that favor its development and spread, but atmospheric conditions which favor bronchial irritation certainly play a part. The incubation period is from two to six days, and perhaps at times the limits are wider. Infectiousness commences early, in many instances before the disease has fairly declared itself. It persists for some time after acute symptoms have subsided, judging by the presence of Pfeiffer's bacillus. While this bacillus appears to be unable to cause influenza in the lower animals, there is abundant evidence that certain animals suffer with symptoms much like those of influenza during epidemics of this disease. During the epidemics of 1892 and 1893, in our army, the disease known as "pink-eye," regarded by many as a form of influenza, was extremely prevalent among cavalry horses.

Prophylaxis.—Influenza is an infectious disease, the spread of which can be checked by isolation; but when the peculiar features of the disease and the conditions of military life are considered, it must be admitted that isolation has its limitations and can usually only mitigate rather than entirely prevent an epidemic. In general, however, it is important as far as possible to prevent the contact of the infected with the uninfected. Soldiers affected with the disease, even in a mild form, should be taken into hospital, not so much for their own benefit as in behalf of others. While the disease prevails, large assemblages should, as far as possible, be avoided. There should be an avoidance of all influences which lower the general tone, and good ventilation and cleanliness of persons and surroundings are of value. The sputum of affected individuals should be treated in the same manner as if it were tuberculous. All handkerchiefs, napkins, bedding, clothing, and other articles used by the sick should be disinfected; though when an epidemic is once fairly established, the infection is so widespread that efforts looking to the control of the disease are of but little avail.

MALARIAL FEVERS.—Occurrence.—Malaria has ravaged armies in every age and climate, and has frequently modified military operations or brought about their failure. Rome was saved from capture by malarial fevers, which so scourged the besieging Gauls under Brennus as to cause their retreat. In the year 208 the Roman army in Scotland lost 50,000 men, out of a total of 80,000, from this cause. No military disaster caused by malarial infection was ever more complete than that of the British expedition to the island of Walcheren, in 1809. On this occasion it has been said that the British were conquered before the battle. Out of an effective force of 39,219 there succumbed to the fever, between August 28th and December, no less than 23,175 men. After the return to England there were 11,503 additional cases. But 217 men, during this disastrous expedition, were killed by the enemy. In the Seminole War, in Florida, our troops suffered severely from malarial infection. In the French army before Sebastopol there were 20,623 cases with 2,179 deaths. In the Union forces, during the Civil War, there were 1,314,744 cases of malaria with 10,062 deaths, giving a mortality of 3.92 per thousand strength. "But though the mortality from these fevers was comparatively light, their influence in detracting from the efficiency of the army was very great," as well as largely influencing the rates of discharge for disability on account of resulting anæmia and chronic malarial poisoning. The so-called "Chickahominy fever" was particularly severe in its effects. Malarial fevers prevailed in the French army during the Italian War in 1859, and during the occupation of the papal states. Ashmead states that from 5,995 Japanese soldiers sent to Formosa in 1873, there were 6,105 admissions to hospital for pernicious malarial fever during a single year. In the French expedition in Madagascar, in 1895, out of a total force of 22,850 men—soldiers and carriers—there were 7,498

deaths; a mortality of about 33 per cent. Nearly all these deaths were from malarial fevers. During this expedition, with its enormous mortality, only 7 men were killed and 94 wounded by the enemy. In the same year a Spanish expedition in the Philippine Islands was scourged with malarial fever. During the last insurrection in Cuba the Spanish forces were largely depleted by malarial fevers of a severe type; the admissions to hospital for this cause, during the year 1897, amounting to 420 per thousand strength. In 1898, after the capture of Santiago, one-half of our forces in Cuba were at one time incapacitated for duty by reason of malarial fever. This grave condition of affairs evoked an appeal to the War Department, signed by all the higher officers, urging an immediate removal of these troops to a more healthy locality and using the sentence: "This army must be moved or perish."

Until within a comparatively recent period, malarial disease, in time of peace, constituted the prime factor in

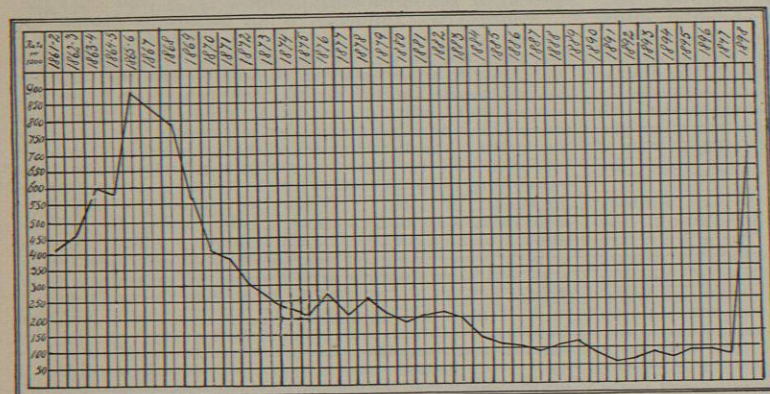


FIG. 1082.—Admissions for Malarial Infections in the United States Army, per Thousand Strength, for the Period 1861-98, Excluding the Year 1867.

the constitution of the sick reports of our army. To-day it occupies a minor position for troops on the home station except for a few posts, the decrease not only having been great but steadily progressive. This reduction has been brought about by the withdrawal of troops from more unhealthy stations and by greater attention to sanitary detail at the few malarial posts at which military necessity requires garrisons to be maintained. During the last quarter of a century, also, the disease—especially in the eastern portion of the United States—appears to have considerably decreased in frequency and virulence. The possibility of retaining troops at stations on the Potomac river, as an example, was long a matter for serious consideration. At Fort Myer nearly all the garrison contracted malarial fevers during the season; of Washington Barracks it was at one time officially reported that during the malarial months there were scarcely enough well men to perform guard duty; and at Fort Washington the prevalence of malarial fevers resulted in the abandonment of the post as a station for troops for a number of years. These posts still lead all other stations in the army as regards malaria, but the number of cases of malarial infection are now very greatly reduced. Following the regarrisoning of Fort Washington, the sick rates at that station have been by no means seriously high. Since the Civil War the admissions for malaria for the entire army, per thousand strength, fell from 793.75 in 1868 to 78.88 in 1897. For the period 1868-84 the admission rates per thousand strength amounted to 331.06; for the decade 1885-94 they were 92.27. The influence of war, and especially the exposure to malarial infection in the tropics, caused an increase to 694.60 in 1898. The death rate, too, was unusually high during the last-named

year, showing the more grave nature of the tropical infections. As far as the United States itself was concerned, the board investigating the occurrence of typhoid fever during the war with Spain came to the conclusion that malaria was a comparatively rare disease among those soldiers who remained in this country. As great as has been the reduction of malarial disease in our own army—to one-tenth of former rates—the improvement in this respect in the German army has been even greater. Official figures for the German army are as follows:

Period.	Admissions per 1,000 strength.
1881-82 to 1887-86	14.2
1886-87 to 1890-91	4.1
1891-92 to 1895-96	1.1
Year 1895-96	.55
Year 1896-97	.45

In the French army the admissions for malaria, per thousand strength, are thus given by Coustan for troops in France and Algeria:

Period.	Admissions per 1,000 strength.
1875-79	30.0
1880	18
1881	25
1882	30
1883	56
1884	15
1885	20
1888	13
1889	16
1890	17
1891	36.1
1892	24.4
1893	14.2

For the British troops on home stations the admissions per thousand strength, for the decade 1888-97, amounted to 6.3. For the year 1898 they were increased to 9.5. In the Russian army the admission and mortality rates from malarial fevers, per thousand strength, have been as follows:

Year.	Admissions.	Deaths.
1890	102.3	7.1
1891	79.9	.05
1892	78.1	.08
1893	79.1	.07
1894	57.6	.08
1895	44.5	.06
1896	46.5	.08
1897	47.3	.07

In the Austrian army the cases of malaria amounted to 50.3 per thousand in 1885; to 30.6 in 1891; to 40.4 in 1892; to 34.7 in 1893; to 28 in 1894; to 26.1 in 1895; to 22.6 in 1896; and to 31.9 in 1897. The deaths from malaria per thousand strength have recently been as follows in the Italian army:

Year.	Death rate.
1893	0.13
1894	.10
1895	.12
1896	.12
1897	.08

Manner of Infection.—Since the malarial parasite has not been observed outside the body, and nothing is known concerning its extra-corporeal existence, it is impossible to speak with certainty as to all the modes of its entry into the system. This very probably occurs in several ways. It has recently been advanced by some that the disease is directly transmitted from man to man only by inoculation, the mosquito serving as the intermediate host and transmitting agent by which infection is brought about. This claim, however, clearly lacks substantiation.

It is a matter of common observation that the infecting organism of malaria must multiply indefinitely outside the body independently of man. In fact, malaria is most prevalent where man is not, and where human beings, through the prevalence of this disease, cannot maintain an existence. Therefore this extra-corporeal multiplication must demand something more than a short cycle from man to mosquito and mosquito to man. Where this extra-corporeal life of the malarial parasite is spent has not yet been scientifically demonstrated, but both analogy and common experience point to water as necessary to its existence. The parasite in the blood is polymorphous, and in the flagellated variety it presents a type well fitted to pursue an independent existence. In water it may assume other and unknown forms quite capable of invading the organism through the walls of the alimentary tract. Certainly this is possible to other somewhat similar forms of life, as in dysentery, and there is much evidence of a practical nature to show that a malarial infection may actually be contracted in this way. Both Manson and Laveran believe that water in which infected mosquitoes have died may cause the disease.

Military history is full of instances in which outbreaks of malarial fever have occurred apparently as a result of the use of impure marsh water, and under circumstances which leave little possibility for infection by other means. As a type of these examples may be mentioned the well-known outbreak of malaria among the French troops on the ship *Argo*, and, like other similar instances, never yet disproved. Further, military history presents many cases in which the rates for malarial fevers were greatly diminished on the substitution of a pure for an impure water supply. In our own service the following instances may be mentioned: Fort Brown, in 1889, had an admission rate for malarial fevers of 1,675.86 per thousand strength, with a rate of 38.58 for constant sickness. Distilled water from the ice-machine was then provided for the use of the troops, and the rates for 1891 became 325.91 and 8.32, respectively. In 1892 the admission rates became 16.13 per thousand strength, and the constant sickness .35. The rates for this post have never returned to even a small fraction of what they were before the introduction of distilled water, and Fort Brown has ceased to be regarded as one of the malarious stations in the army. At Fort Ringgold the admissions for malarial fevers amounted to 2,304 per thousand strength in the year 1885. Distilled water was supplied for the use of troops—though its exclusive use was not compulsory—and in 1889 the rates had fallen to 562 per thousand strength. At this time there was considerable field service among the troops stationed at Fort Ringgold, and the post surgeon reported that he believed every case of malarial fever could be traced to an infection acquired outside the post. In 1897 the admissions for malarial fever at Fort Ringgold amounted to but 89.42 per thousand strength. In the experience of the writer, at Jefferson Barracks, the soldiers of that station were severely affected with malarial fevers. On the introduction of boiled water a marked reduction in malarial affections was apparent. Among the officers and their families at this station, who were careful to drink boiled or imported spring waters only, not a case occurred save in two children, who were shown habitually to use water from impure and unauthorized sources. Later, at Washington Barracks, it was observed that among the two batteries of artillery, who drank unfiltered water, the proportion of malarial cases was four times as great as among the men of the Hospital Corps Company of Instruction, having an average strength of about 150 men, who drank only water passed through Berkefeld filters.

Such instances as the above may be largely multiplied, and serve to emphasize the fact that, however else the malarial organism may gain access to the system, its entrance by means of the water supply should never be disregarded by the military sanitarian. Grawitz has shown, in connection with the infection of malaria by mosquitoes, that the disease is most common in the German army during spring when mosquitoes are not especially active, and

he regards a water supply above reproach as a necessity in preventing malaria. It is true that a number of experiments have been made in the attempt to cause malarial infection by way of the alimentary tract. Healthy persons have been allowed to drink the water from supposedly malarious marshes; nemata of similar waters have been given to other individuals, and even the blood of malarial patients has been drunk by uninfected persons. These experiments were negative in their results. In the absence of positive knowledge that the water contained malarial organisms in the proper stage of development, the first experiments prove nothing; as for the experiment with the infected blood, it may well be that in this intra-corporeal stage the parasite has little powers of resistance against the digestive juices. In the light of the instances above quoted it may fairly be assumed that some important factor present in natural infection was inadvertently omitted from the experiments. On the other hand, besides abundant experimental evidence to the contrary, the theory that malaria is transmitted by water alone is refuted by the fact that men on board ships anchored off a malarial coast, who may not have been on shore and have used nothing but distilled water, often contract malaria. There is a very general impression that infection can occur through the respiratory tract, though in the absence of definite knowledge concerning the life of the malarial parasite outside of the body, it is evident that this point is not susceptible of absolute proof. Sleeping on the ground, where the emanations of a supposedly malarious soil are inhaled during repose, has long been thought to favor the prevalence of the disease among soldiers. It should not be forgotten, in this connection, that a wind which serves to carry a so-called malarial miasm may also carry insects serving as hosts for malarial parasites.

As a result of modern investigation, the occurrence of the disease through inoculation by infected mosquitoes has been scientifically demonstrated, and it appears probable that the organism frequently gains access to the blood in this manner. It has not, however, been shown that mosquitoes in a known malarial district harbor this parasite except after sucking the blood of an infected individual; and what part they play, if any, in the origination of the first cases of the disease occurring in individuals penetrating a previously uninhabited region has not as yet been worked out. That healthy persons may be directly inoculated by mosquitoes which have sucked the blood of a diseased individual there is no doubt.

Predisposing Causes.—Excluded from the Arctic zone, malaria appears to increase in frequency and virulence as the equator is approached, but this progression lacks both constancy and uniformity and does not exactly correspond with the isothermal lines. Certain tropical countries, like Australia and New Caledonia, are free from these fevers. In the island of Réunion, where it was formerly unknown, it has recently appeared, presumably imported by French troops from Madagascar, and now, according to Manson, it causes one-third of the deaths from all causes. In general, however, the disease bears a close relationship to warm climates, and of late years high mortality from malaria has occurred only in the tropics. In this country the rates for malarial disease are greatest among troops stationed in the southwest and in the Mississippi basin, although the few posts on the Potomac river are notoriously malarial. During the Civil War, statistics gathered by the sanitary commission showed the number sick from malaria per thousand to be proportioned as follows:

In northern posts at a distance from the sea and great lakes, 151; in the lake region, 193; at seaboard stations, Delaware capes to Savannah, 370; on the lower Mississippi, 383; in Eastern Florida, 520; in the southwest, 747.

Among our troops now stationed in Cuba and Porto Rico the rates are high, but in the Philippine Islands the rates for malaria have been unexpectedly low. For the world at large the present distribution of malarial disease, as affected by climate, is well shown by the fol-