ON THE PREVENTION OF MALARIAL DISEASES.

BY DR. CHARLES SMART, U. S. A.

Perhaps we incline to regard the undiscovered cause of malaria as more of a mystery than the equally unknown causes of other diseases, because its effects are so varied, the same poisonous exhalation, vapor, germ, whatever it may be, producing disorders of the system which may or may not be developed into intermittent, remittent, or pernicious fevers, with deadly congestions, hemorrhages, dysenteries, neuralgias, organic changes in the abdominal viscera, and even disorganization of the blood. Yet we really know more about it than about the cause of many a disease,—pneumonia, for instance,—which is more specific in its symptoms and formal in its progress. We know that whenever we have organic matter in the soil in conjunction with a certain amount of water and a certain degree of temperature, malaria will be generated and evolved, no matter what the latitude, longitude, or altitude, and that it will be wafted by the winds, intercepted by foliage, and absorbed by water.

But there are a few points connected with its natural history which we do not know and shall not be able to understand until the cause is unearthed, and malaria loses the generic vagueness of its Italian name and is specifically recognized. Our fathers of a hundred years ago were hopeful of reaching this point; but the years have passed, science has progressed, and we seem no nearer the end than they assumed themselves to be. Retrospect in this respect is depressing; but the failures in the past are a part of the progress of to-day, if we would only permit them to remain on the record as failures, and not waste time and energy in attempts to resuscitate them. Hypotheses, such as that referring the origin of malarial disease to dampness and temperature changes, are brought up repeatedly. Even the baseless idea that the carbonic acid of the atmosphere is the poisonous agent appears occasionally. Three or four years ago, an article in the Transactions of a state society proved to its author's satisfaction that carbonic acid is the cause of all our endemic troubles; while more than fifty years before, in the Medical Recorder of Philadelphia (1824), Dr. Causin discussed the same idea, and expressed himself as "well satisfied that this theory may be defended at all times and at every point without violating in the slightest degree any cardinal principle of philosophy." From such discussions, however, we do not look for progress. If we do permit ourselves to theorize, every weak point must be assailed by experiment and critical observation, the results of which when put upon record will have a value for the future, although
the idea which originated them may have been subverted by their testimony.

The theory that a malign influence or poison is generated and exhaled from the organic matter of the soil under the specified conditions, and absorbed into the system by the pulmonary and cutaneous surfaces, or, perhaps, introduced into the intestinal tract by condensation and deglutition, has been accepted so cordially by the profession, that suggestions of other modes of entry than by the air have been for years neglected or repressed as disturbing to the unanimity of opinion which had been reached. Nevertheless, the low-lying aerial miasm has not sufficed to explain all the observed facts. We have malarial fevers in districts where the conjunction of the recognized conditions is not discoverable, all due allowance being made for a limited portability by aerial currents. We have malarial cases even in districts which are covered with snow, and where the temperature for months has been at or below the freezing point. Cases also occur of aggravated type in cities where drainage, sewerage, and cellarage have dried the subsoil and paving has sealed its surface, at times when the temperature has been unfavorable to its development, even in soils otherwise congenial;—so that the unqualified adherence to an aeriform propagation leads to the sanitary inspection of a flower-pot on the bedroom window-sill, and lays the charge of malarial madness on the profession. These obscure cases, however, become susceptible of explanation without a recourse to infinitesimals in etiology, if we allow the possible introduction of the poison by water carriage.

Colin failed to find that marsh and other stagnant waters produced intermittents, and regards himself as having failed to find that they produced malarial disease: but these obscure cases are never intermittents; they are irregular fevers of a remittent or continued type and adynamic character. The natives of malarious countries hold very generally that there is danger in drinking the surface waters. Sir Joseph Fayrer, in his Croonian lecture (British Med. Jour., April 1, 1882), says,—"The natives of India attach little importance to atmospheric states, but believe that the water of pools, tanks, or even of streams flowing through certain jungles or marshy places, is charged with the fever poison." The villagers of the malarious plains of the Crimea informed Dr. Parkes that those who drank marsh water had fever at all times, while those who drank pure water got ague only during the late summer and autumn months. Malarial fevers have been recorded as occurring in ships at sea on account of exhalations from organic matters in the hold or bilge; but in M. Boudin’s celebrated case, exhalation must undoubtedly be excluded. The transport Argo sailed from Bône for France with one hundred and twenty soldiers, and of these thirteen died on the short voyage, and ninety-eight were landed at Marseilles suffering from pernicious malarial fevers, which yielded as if by enchantment to quinine. Four casks for the soldiers’ supply had been filled with marsh water at Bône. The crew of the vessel were unaffected: they had a different water supply. Other transports sailed at the same time, but none of them suf-
fered from fever: the Argo was the only vessel which stored the marsh water. M. Colin disposes of this case by declaring that he does not believe it; that M. Boudin must have made a mistake; that the cases must have been typhus or dysenteric, because he himself never met with any experience of this nature. This case is unique in the history of malaria. Its testimony is guarded at every point;—exhalation from the soil is precluded; exhalation from organic matter in the ship is precluded; exposure to miasma before embarkation is precluded;—and M. Boudin, who treated the cases in the hospital at Marseilles, testifies most definitely to their malarial character. Instances where the conditions are so perfectly arranged to test a theory or determine a cause are rare in the history of medicine.

That there should be in malarial literature a scarcity of cases in which suspicion has attached to the water supply is not surprising, when we consider that malarious waters, if such exist, must usually be found in malarious districts, where the propagation of the disease can plausibly be ascribed in all cases to aeriform transmission, anomalous cases being anomalous only so far as we are unable to distinguish the causative conditions, which nevertheless are assumed to exist because the disease occurred. At the same time the attention of the profession has not been directed to the possibility of water infection. On the contrary, some writers have scouted the idea of propagation by this means. In an old medical journal (Transylvania, 1828), to which I had occasion to refer recently, John Esten Cooke says,—"Bad drinking-water has also been considered by some as the cause of these [malarial] epidemics. A single consideration will show the incorrectness of this opinion. Epidemics occur in hot weather particularly, and therefore nothing present throughout the year can be the cause of the disease." The water supply is here assumed to be always the same; but an unprejudiced critic even then might have disproved the assumption by the experience of the senses.

Certain waters containing organic matter, those especially which are spoken of by medical writers as "bad waters," are well known to produce diarrhœas, but that this is the only evil effect resulting from organic impurity in water is now recognized to be erroneous. The specific poisons of typhoid fever and cholera have been traced to the water supply in many instances; but to do this in the case of malaria is difficult, for the reason already given. Yet while the published cases of suspected malaria are few, there is an unwritten record in medicine which is not lost, though unpublished, but has its influence on progress. I allude to the experience, not of the few who have time to express themselves in the journals, but to the many who have not. This unwritten record is disposed to acknowledge the existence of malarious waters. Among the physicians of our malarious sections will be found many whose experience inclines them to this view, although no special instances are brought forward to which exception may not be taken on account of the difficulty of excluding the possibility of aerial transmission. Occasionally in reports and papers a similar belief is acknowledged;—thus, in the article
"Malaria in Connecticut," in the Report of the State Board of Health for 1881, Dr. Swift, of Colchester, suggests that shallow wells, affording only surface water, are, among other things, a prolific source of typho-malarial fever.

In an article in the American Journal Medical Sciences for January, 1878, the connection between the malarial remittents of the Rocky Mountain region and an impure water supply is demonstrated, and the impurity traced, not to swamps, pools, dams, and overflows amid decaying vegetation, as was suspected, but to the rains and snow-meltings which periodically flood the rivers. In Buck's Hygiene, vol. 2d, pp. 132 and 145, this subject is again taken up, and an interesting case quoted from the experience of Dr. John Milhan, who reported in a command of nineteen officers and three hundred and forty-eight men the occurrence of fever in five officers and one hundred and five men, with cases in addition among the teamsters and herders of which no record was kept, and definitely charged the snow water, pure and clear as it seemed, with the causation of the disease. Rain and snow are impure as they fall from the clouds, and the malaria present in them must come from other and distant localities. Nor is it difficult to allow the possibility of transmission in this way, when we know that the pollen grains of Southern plants have not unfrequently been precipitated as a yellow rain upon our Northern soil.

Since then I have met with several cases where remittent fever has occurred concomitantly with the use of an impure water, and where exposure to malarious exhalations has been more or less excluded. Some of these may be particularized by way of illustration. The raised wooden tanks of New Orleans are, from our point of view, presumably the cause of much of the malarial disease in that city, but the water supply is seldom questioned, as the neighboring swamps are conceived to account satisfactorily for all cases. Nevertheless Dr. Joseph Jones speaks of the well paved and non-malarious parts of the city. A sample of cistern water from one of these well paved and non-malarious sections was sent by the late Dr. C. B. White for examination, as lead contamination was suspected. No lead was present, but the water approximated in character to that of the swamps, and was reported as highly dangerous from malarial possibilities. On the receipt of the report the use of the cistern was interdicted, as dynamic remittent fever was present in the house supplied by it in the person of a woman who had not been away from the vicinity of her home for months.

In October, 1879, while examining the water supply of Jackson, Mississippi, I was taken by Dr. Wirt Johnson to see a case of malarial fever, simulating yellow fever, in a negro woman. She had not been away from her home in many months, but the water in her cistern was low, and gave results on analysis and under the microscope similar to those derived from swamp water.

It would seem at first sight scarcely allowable to reason from the cistern water of a negro cabin in Mississippi to the public supply from riv-
ers and lakes of such cities as New York or Boston, and yet the cases are parallel. Rain water from a given water-shed is collected, stored, and drawn off for use. The city supply has more or less of spring water admixture, and becomes purified in its flow over the surface by oxidation and nitrification; but there is ground for believing that this oxidation does not attack the malarial poison. Dead organic matter given up to chemical and other agencies disappears from the water, but the malarial poison is not affected by these agencies, else its diffusion in the air, its fall with the rain and snow, would destroy it, and we should have no records of malarial cases in the Rocky Mountains, such as have been given by Dr. Milhau and others.

The reports of the health officers of our cities show that malarial fevers are by no means an infrequent cause of death. From reports rendered to the National Board of Health, it is found that during the year ending December 31, 1881, these fevers caused the death of from four to six persons in every ten thousand of the population of the cities of Louisville, Ky., Wilmington, Del., Paterson, N. J., New Haven, Conn., New York, Yonkers, and Brooklyn, N. Y., Holyoke, Mass., and Nashville, Tenn. Evansville, Ind., lost thirteen in ten thousand from these diseases, Memphis, Tenn., fourteen, New Orleans, La., sixteen, and Savannah, Ga., seventeen; San Francisco, Cal., lost only four in one hundred thousand. It is singular that so many of these towns should have a death-rate varying only from four to six in ten thousand, and that these should include Holyoke, New Haven, and Yonkers, as well as Louisville and Nashville. The three factors, heat, moisture, and soil, can scarcely be assumed to account satisfactorily for this singularity in the death-rate; and if not, has the water supply a connection therewith, as it undoubtedly has with the malarial fevers of certain parts of our Western territories? The influence of local swamps is seen in the larger death-rate affecting some of the other towns mentioned.

It may be suggested that if surface waters are accountable for the sickness which corresponds to an annual death-rate of four or five per ten thousand in our cities, the profession in Britain, who have gone into sanitary questions with so much zeal and persevering energy, would have detected the connection. But the conditions are different with them. We have malarial diseases in our cities; we have also vast malarial tracts in the interior of our country, which may poison the air and the rain-clouds which sweep over them. They are notably free from malarial troubles, and their rain-fall is purer than ours—known to be so by analysis—and readily acknowledged to be so when its derivation by evaporation from the ocean surface is considered. San Francisco is similarly situated in this respect, for, while exposed to showers which come from the Pacific, it is protected on the east by mountain ranges which intercept the impure clouds from that direction. Moreover, the English take care of their water supplies: we do not. Two months ago, while the authorities in London were endeavoring to suppress some work which caused a dust in the vicinity of the filtering-beds of one of the water
companies, the city council of New Orleans was establishing a nuisance-
wharf within three blocks of the in-take of the city water supply, and
with an in-shore, up-stream current between the two points.

If the surface waters, which constitute the general water supply of our
cities, have at any time a causative connection with the malarial disease
which infects them, it is important that we should know it; for were it
so, the remedy is in our hands. The well waters of malarious districts
do not convey the specific poison. In those parts of our country where
remittents prevailed without any local sources of exhalation, the disease
disappeared as settlement was effected, and the pond, tank, or running
stream which furnished the water supply of the pioneers became replaced
by the purer waters of the wells dug by the permanent settlers.

Sometimes well water is accused of causing malarial fevers, but there
is always a surface inflow in the case. Thus, to take one of the instances
collected by Dr. Mallet, in his recent investigation into the methods of
water analysis: Dr. C. Drew, of Jacksonville, Florida, submitted the
water of a well which supplied a family of twelve persons, five of whom
had been attacked with fever like obstinate remittent in some, in others
like well-marked typhoid: the well received surface water.

While sewerage irrigation and farming, as at Croydon, in 1875-'76,
appear to indicate soil-filtration as efficient in removing the typhoid poi-
son, the Lausen and other epidemics make us hesitate to accept this as a
general truth; but no shade of suspicion attaches to percolated waters
when malaria is under consideration. Filtration is the remedy, and it is
one which is readily applied.

These views are submitted to the Association, not as sustained by the
testimony brought forward, but as having so much support from observed
facts as to merit consideration and to call for a close and continued study
of the modes of entry of malaria into the system, to the end that if sus-
tained, the remedy which involves only an outlay of money may be
applied.