

by referring to the figures in the table, we find that they evacuate during the year 35,714 tons more on days of decreasing readings of the barometer and thermometer, than on days of increasing readings; 7,142 tons more when the humidity of the air is decreasing, than when it is increasing; 26,785 tons more on days when there is ozone, than on days of no ozone; 35,714 tons more with directions of the wind from south, than from north points of the compass; and 276,785 tons more during calms and gentle variable breezes, than when there is a moderate current of air.

Taking the adult population of London as two millions, and assuming that all the solids secreted by their kidneys are carried into the Thames, that river must hold in solution, or have suspended in its waters, a mean daily supply of 181 tons of solid urinary products. The quantity, however, varies with the weather; for, according to the above results, the Thames will contain ten tons more on days when the readings of the barometer and thermometer are decreasing than when they are increasing; a daily mean of three tons more when the humidity of the air is decreasing than when it is increasing; seven tons more on ozone days than when there is no ozone; about ten tons more with south than with north winds; and a daily mean of seventy-five tons more during calms and gentle breezes, than when there is a current of air. Let agriculturists bear in mind, that from the action of the kidneys alone of a London population, 66,016 tons of British guano are annually swept into the Thames.

The quantity of solids excreted in twenty-four hours ranges between 650 and 1,381 grains, giving a range of 1,181 grains. The greatest quantity of liquid evacuated in twenty-four hours was 115 ounces, and the smallest 20, giving a range of 95 ounces. On the day on which the greatest quantity of solids occurred, the reading of the barometer, which was decreasing, was 29.764 in. The wind was south-east; and ozone was perceived on the previous and following days. On the day on which the smallest quantity of solids was observed, the barometer reading (the commencement of a period of increasing readings) was 30.040 in.; the wind veered from south-east to north-west. There was a trace of ozone, which had not been detected for two days, and it was not again perceived for a week. It then reappeared with the commencement of a period of decreasing readings of the barometer, and an increase of the quantity of solids in the urine from 650 to 1,379 grains.

The mean quantity and density of the urine I have given is above that of Drs. Prout and Golding Bird, and M. Becquerel. By the former, from 30 to 40 ounces are given as the mean daily quantity of fluid, at a mean density of 1,017; by the latter, the average quantity is stated at 45 ounces. I do not know from what number of observations these results were arrived at; but I do not hesitate to say that if they did not extend over a period of at least one year, very little dependence can be placed in them; for the physical character of the urine is as variable as the wind. To show how much the quantity of solid urinary products varies at different seasons, I may mention that the mean daily quantity for the three months, April, May, and June 1855, was 1,427 grains; while that for the three months ending September was 1,192 grains, giving a difference of 235 grains. I may also state that the extreme quantities occurred once only in twelve months. To arrive at anything like accuracy, the urine of several persons should be examined daily for a period of two years at least.

The period over which this investigation extends is too short to allow of anything like reliable conclusions; but it may be stated that there is a greater quantity of solids excreted by the kidneys during decreasing readings of the barometer and thermometer than when the readings are increasing; that the quantity is greater during ozone than during no ozone periods, and with directions of the wind from south than from north points of the compass; and that it is greater during calms than when there are atmospheric currents.

It also appears that the quantity is greater with dry

than with moist air, which may be owing to the cutaneous exosmosis being increased by the moisture in the atmosphere. We observe, then, that warmth and moisture of the air diminish the quantity of solids in the urine; and it is worthy of remark that Mr. Copland Hutchinson attributed the rarity of calculus among sailors to their sleeping in the lower decks, where the temperature and moisture of the air are increased to that degree, that the place becomes a vapour bath. The smaller quantity of liquids and solids in the period of the day between eleven A.M. and five P.M., may be attributed to the free action of the skin while the body was exposed to the open air.

It also appears that the quantity of solids is greater at the commencement of periods of decreasing readings than at the period of increasing readings; and it is with the former class of readings that the maximum of diseases takes place.

It also appears that while the urine of one person gives signs of functional derangement, without any apparent disease, under certain atmospheric changes, another person may be seriously ill under similar conditions of the air.

CONSIDERATIONS RESPECTING THE OPERATION OF MALARIA ON THE HUMAN BODY.

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[Concluded from page 724.]

l. Inflammation. The production of inflammation by malarious poison appears to be sufficiently elucidated by what has been above said. The essential visible circumstance in inflammation is stasis of the blood in the capillaries, while afflux persists. The natural vital power of the part is, at the same time, nullified, and all normal nutrition for the time ceases. Now, if the vital power of a part be weak, it becomes more depressed and overwhelmed at length by excessive hyperemia, which thus becomes a cause of actual inflammation. This is just what happens when the sympathetic is divided in the neck of a weakly animal, and severe conjunctivitis occurs in consequence; while in a stronger animal, the inflammatory tendency is resisted. If, therefore, the sympathetic plexuses of the liver, the large intestines, or the stomach, be paralysed, we shall have the capillary systems of these organs flushed with blood; and if their vital power and tone be low, phenomena of more or less absolute inflammation will occur, and there will be hepatitis, dysentery, or gastritis. In the same way are produced the febrile pneumonias of which Dr. Morehead speaks. On mucous surfaces, owing to their great vascularity, and the thinness of their epithelial covering, there will be a great tendency to the early occurrence of exudation, consisting of modified liquor sanguinis, sometimes mingled with red globules. Varying conditions of the tissue, which it is impossible to specify, will determine whether the exudation shall be a serous profluvium or a mass of gelatinous mucus. The occurrence of the exudation relieves the hyperæmia; and if the vital power be not too much depressed, or if the determining cause of the congestion cease to operate, the stage of complete inflammation may never be attained. Here, as is continually the case, we find that the majority of instances do not attain the complete and perfect type, but occupy one of the many intermediate grades. It is a very curious thing that in certain conditions of the alimentary mucous surface the sanguine afflux, or the nerve disorder, that mostly issues in serous or mucous discharge, produces instead a copious extrication of gas. I have observed this when dysenteric disorder has been giving way to health.

c. Secretion fluxes are evidently produced much in the same way as the last mentioned phenomena. There is the same hyperæmia, and from the same cause; but instead of its overmastering the vital power of the tissue, the latter remains predominant, and converts the hyperæmic flux into an excessive secretion.

d. There are two common forms of disease which I wish

here briefly to allude to, since, while they occur beyond question far more commonly from other causes than malaria, yet their occasional production by this agent seems to me to be very significant of their true pathology. I refer to *skin-diseases* and *catarrh*. In his work on the diseases of Minorca, Cleghorn states that "the *essere*", by which he evidently intends urticaria, or lichen urticatus, "often accompany tertian fever, and appear most commonly in the hot fit. Sometimes I have seen them so numerous that the whole body was disfigured by them, and painted in many places with all the colours of the rainbow." Bark, he adds, after sufficient evacuations, effectually cures both them and the fever. Rayer mentions a *roseola cholericæ*. Cutaneous erythemata occur in connexion with abdominal neuralgia. A curious case has been related to me by Mr. Martin of a lady who had suffered from frontal neuralgia and malarious fever, and in whom a largish patch of redness used to appear on the right forearm, from which such an abundant moisture flowed, that several handkerchiefs would be saturated in about half an hour. This is not very unlike chronic eczema. Cases occur to me of children suffering from cachectic vesicular eruptions, nocturnal perspirations, with occasional attacks in which they are said to look ghastly, or seem to be dying. They benefit under arsenic and ammonia, and their general aspect is that of chronic malarious disorder. The association of herpes zoster and neuralgic pain is notorious. Skin disorders prevail or return at the same seasons as malarious fevers; like them, they are vernal or autumnal. If, now, in addition to these indications of relationship between the two classes of disorders we consider the very positive efficacy of arsenic in curing both, it must, I think, be acknowledged that there exists a good deal of evidence in favour of the view that skin-diseases are chiefly the result of disordered innervation, and that their cure is to be sought rather in giving tone to relaxed vessels, and relieving inflammatory congestion than by seeking to eliminate a supposed *materia morbi*.

Not a few circumstances indicate a good deal of affinity between catarrh and malarious disorder. What is dysentery or diarrhoea, so long as they do not appear in their more aggravated forms, but a catarrh? The catarrhal inflammation is just such as occurs in the milder forms of dysentery; it is a hyperæmia rather than a true inflammation with blood stasis in the affected tissue. The same treatment is applicable to both in their different stages. If a common inflammatory catarrh of the respiratory tract is influenced very decidedly by ipecacuan, so is sthenic dysentery. Acids and astringents are beneficial in the chronic forms of each disorder. Taking influenza as one very marked variety of catarrhal disorder, we find Huxham thus noticing its intermediate position between malarious fever and inflammation: "I well remember that the catarrhal fever, which spread through all Europe under the name of influenza in the spring, 1743, frequently became pleuritic, or peripneumonic; and as frequently, after two or three days, ran into a quotidian, or tertian; the difference of the constitutions, etc., thus altering the face and nature of the disease." Of the epidemic in 1782, Dr. Cleghorn, of Dublin, says, "After the influenza had continued some time, the weather became hotter, and the symptoms were different; the fever became remittent, and in some intermittent." Dr. Petrie, of Lincoln, states that about the middle of June it attacked the lungs in the shape of pleurisy and peripneumony: but "about the middle or end of July it began to abate, and to appear like an intermittent." The sudden and extreme prostration, which especially distinguishes influenza from all other catarrh, is a point on which there is a marked resemblance between it and fevers. The following instance reminds one of the invasion of a pernicious intermittent. E. S., aged 5½ years, a girl, who had been ill some months with chronic bronchitis, and had, every now and then, nocturnal febrile paroxysms, had been improving under citrate of iron, and quinine, and cod-liver oil, when, on April 3rd, during the prevalence of influenza, she was attacked in the following way. At 1 P.M. she became deadly pale for half an hour, after which her usual colour re-

turned. Between 4 and 5 P.M. she got cold, face and arms "purplish" for about three-quarters of an hour, and again she resumed her natural condition. At 9 P.M. she appeared as if she were dying; was unconscious, fixed her eyes, and threw her head back, but was not cold. This state continued for one hour. That day she had no cough, but it came on soon after with marked aggravation of the bronchitis. Under two grains of quinine three times a day she improved a good deal. The paralyzing miasm in this case seems to have acted more on the sympathetic than is usual in influenza. Dr. Copland observes: "that there is something in the air, often producing catarrh, beyond what is perceived by our senses, is shown by the very general or even epidemic prevalence of the affection during states of the weather and of the air, in which nothing can be observed." He finds that whenever he has gone any distance into Essex—in many parts a malarious region—he has returned with catarrh. The influence of cold in reproducing agues, as well as the catarrhal disorders which have their popular name from it, is surely remarkable. It may well be compared with the origin of dysentery, diarrhoea, and fever, simultaneously in different individuals from a single exposure to malaria. Even a sneeze, though a minimum disorder, contains two morbid elements, of which one belongs to the catarrhal, the other to the malarious class. The pain or peculiar sensation is neuralgic; the exudation is the result of slight hyperæmia, no doubt of nerve origin. Magnify these elements greatly, and there would result an ague with dysenteric complication. The following instructive instances have been related to me by medical friends. A man had shiverings, with severe neuralgia of the head, and a tremendous muco-purulent discharge from the left nostril. He was cured by quinine. A gentleman used to suffer from catarrh severely, the disorder continuing many days, and running on into bronchitis. He now arrests it by a good dose of quinine, combined with opium.

I have no idea in these desultory remarks of attempting more than to point out some of the affinities between certain common disorders, and to show how much there is of real resemblance between them in regard of their pathology. This will, I believe, be far more likely to enable us to recognize and comprehend unusual forms and states of disease than any minute symptom-seeking, or specifying and distinguishing varieties, as if one were quite dissimilar to another.

8th. As respects the occurrence of malarious disease in London, I submit the following consideration. Is it not possible that a weak malaria may be generated in the very streets? If a drying surface be the one necessary condition for the production of the poison, is not such constantly afforded by the larger Macadamised thoroughfares? Dr. Copland acknowledges this as a probable source. Again, what shall we say to the river banks which, as the tide recedes, expose such extensive muddy surfaces to the action of the wind and sun? Can we be sure that these do not generate malaria? To the east of London there are extensive flat marshy tracts, especially along the Essex side of the river; on the other side, from Gravesend up to Putney, there is much flat, ill drained land along the course of the river; and the Middlesex side, from what I have observed, I should judge to be in much the same state. It cannot, I think, be affirmed that the generation of malaria in these places is unlikely. The tidal ditches, which serve often as sewers to large districts, and give off offensive emanations, may be looked upon pretty certainly as even more injurious than the Thames, into which they discharge their contents. Their banks, as the tide falls, must expose drying surfaces of foul mud. In reference to one of these, the Effra, at Kennington, I may mention the following case. A gentleman, who had suffered from malarious fever in the East, but who was quite well at the time alluded to, spent one day at a house behind the garden of which this so-called river flows. While sitting in the garden, near this stream, he perceived an offensive odour. He returned to London that evening, and was attacked the next day with ague. Two relatives had died in the same house, one with cholera,

and the other with fever. The following cases from Dr. McCulloch's work on the *Production and Propagation of Malaria*, pp. 89, 93, 108, are of importance in relation to this subject. "The castle of Flamandville, near Guellette, in Normandy, is situated on the high lands, where no epidemics of this class are known; but, being surrounded by a moat, it has, for generations, been noted for the bad health and destruction of its inhabitants. . . . To mention but two facts more, one of which particularly proves the insalubrity of such works; it had been suspected that the fevers at Bourg-en-Bresse, which, down to the middle of the last century, had so tormented the inhabitants that half of them were incapacitated for a third of the year, arose from the ditches of its fortifications. These were consequently filled up, with the result of effecting an entire change, in the disappearance of those fevers. Lastly, it had been observed that at Havre de Grace the soldiers were seized with headache and giddiness within five minutes after approaching the ditch, with the usual consequences of fever, and that fever, of course, of a violent character." He refers, also, to one instance "notorious to the medical establishment of Woolwich in those days", of a pond occupying an old gravel pit on the Common, close to a house, the extent of the pond being but a few square yards. "It was remarked, for a long course of years, that the inhabitants of this house suffered under perpetual agues; and it was not until this pond was destroyed by the alteration of that Common that the disease disappeared, and for ever." These instances are sufficient to prove that circumstances, not usually suspected, may give rise to malaria. I have no other proof that our canals may give rise to malarious disease than the observation of a friend relative to a number of cases of intermittent fever occurring in the vicinity of the Paddington canal; but the interesting results obtained by Mr. Dempster should be borne in mind. He finds that within half a mile of the Great Ganges canal, in India, the percentage of cases of enlarged spleen, as determined by manual examination, is notably greater than it is beyond that distance. The average taken from six different localities gives a ratio of 41 to 31 nearly. It is, I think, to be considered that aguish disorder may very probably prevail in a greater or less degree, according to the special constitution of different periods. Dr. Copland cites two authorities as maintaining the opinion that other causes besides malaria can produce ague, because of the rarity of that disease in London from 1800 to 1822 or 1823, and its frequency since. He also refers to the epidemic prevalence of agues as a tolerably well established fact admitted by most writers. Dr. Watson, speaking of the rarity of ague in London, says, "except in the year 1827, I have never since I have been in practice known ague to be at all common here." This is an admission that in that year there was some special condition which favoured their production. I have already referred to my own personal experience of aguish disorder during the last cholera epidemic, and to the great prevalence of neuralgic and aguish disorder ever since. It seems to me that from that time a tendency to irritation or paralysis of nerves and nervous centres, cerebro-spinal and sympathetic, has been generally prevalent. In an excellent short treatise on cholera, Dr. Cormack notices the occurrence of ague and neuralgia as predominating forms of disease during the cholera epidemic of 1848-49. He does not, however state whether they continued any length of time after the subsidence of the epidemic; they were observed at its advent and departure.

A circumstance, as it appears to me, of great efficacy in promoting the liability of the system to be affected by malaria is the debilitating influence of a residence in London. It is perfectly notorious that debility, however induced, is the very soil, as it were, on which malaria takes root, and that the best prophylactic means are those which strengthen and fortify the system. Now, if the nervous energy be much weakened and lowered, either by fashionable dissipation, or by the privations and exhausting toils of poverty, it is but reasonable to expect that a weak dose of malaria, such as an adult of ordinary vigour would repel

with ease, will operate injuriously on the system. Its effects may be very various; it may induce the chronic obscure remittent, or intermittent, so well investigated and described by Dr. McCulloch, or a neuralgia of any part where a nerve exists, or some cerebral disorder, or a hæmorrhage, or inflammation of some locality by paralysis of its vascular nerves. It may often happen that the sufferer has received the malarious impregnation elsewhere, and that the debilitating urban influences have only excited the latent morbid element into activity. Of this, I have mentioned an instance above.

My wish in the foregoing pages has been to draw attention to malaria as a very possible cause of disease in our own vicinity, especially as the most probable cause of much obscure disorder and ill health, as well as sometimes of severe and dangerous affections. I have not attempted to define malaria, or to propose any test for it. I believe the human body is (unfortunately) the most sensitive test, especially when in a state of debility. I have not sought to inquire particularly into its nature, to speculate whether it be an allotropic form of vapour, but rather to trace its mode of action upon the living frame. I have rather endeavoured to find indications of its causal relation to other diseases, than to restrict it to the production of a particular type. My view is that it is to be regarded as a world-wide cause of disease, by no means manifesting itself in the sole form of ague, or remittent fever, but potentially in any and every form of morbid action that nerve disorder can initiate. While we really know nothing more of malaria than that it seems in some way to result from the evaporation of water, or rather from the drying of ground that has been wet; when we know what an amount of disease it produces where its intensity is great; and when we find among ourselves no small amount of disease resembling its effects in other lands, but with characters attenuated and softened down, I cannot think that it is transgressing the limits of rational investigation to propose the hypothesis that an influence like, if not identical with tropical malaria, is present among us, though in a dilute and often modified form. It were almost as philosophic to refuse to acknowledge the presence of malaria, unless agues or remittent fevers were prevalent, as it would be to deny that a patient had phthisis until large cavities were formed in both lungs.

In the discussion which followed the reading of the paper, the following very valuable remarks were made by Dr. Headlam Greenhow: "As regards bronchitis and influenza, there is some relation between influenza and ague, and also between many cases of bronchitis (?) met with in London and ague, using the latter term in a wide sense, as applied to the malaria of ague. The influenza of 1847 very often assumed an aguish character, exacerbations of the disease preceded by anomalous pains, cough, rigors, heat, and sweating, with loaded urine, recurring periodically at tertian or quartan intervals. I saw, perhaps, eight or nine cases of this character, which were more like ague than influenza, but evidently due to the cause of influenza, whatever that may be. Probably but for my own severe illness I should have seen more of the same description. In my own case, the attacks went on for nearly a year about every sixth day, the only intermission of any length being one of a month, whilst I was absent from home, and finally only left me on my taking a complete holiday. They were so similar to ague, that, although much emaciated, I was pretty well for nearly a week, and on the day of attack went about my usual professional occupations, until an indescribable sensation warned me of the approaching accession. Usually about 3 or 4 p.m. rigors came on, their duration varying from a quarter of an hour to nearly two hours, followed by the hot and sweating stages. The attacks were invariably accompanied by pain in the left scapular region, and cough, which continued with mucous expectoration for a day or two. In my own case, quinine did me but little good; but in practice I always took the intermitting character of the attacks as a clear indication for its employment, and always with benefit."