

NOTES ON THE CAUSATION OF PERIODIC FEVER.

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The Narbada Valley holds an unenviable notoriety for fevers and Hoshungabad may be taken as a fair representative station, and the accompanying statistics collected here will apply equally well to the whole valley. The data are taken from my own dispensary register and can be vouched for, and the meteorological observations have also been recorded under my own superintendence. The rainfall however extends beyond the period of my residence here, but I have every reason to believe it correct, and I give it for as many years as I can, because the fall varies a good deal if taken one year with another; and in the ten years of which the average is given, it varied from 76·30 inches in 1867 to 29·60 inches in 1868; hence, to get a fair average, it was necessary to have the records of as many years as possible. I also give the two years' register of sub-soil water-level, because 1870 was one of these dry seasons, the rainfall being only 35·70 inches, whilst 1871 had excessive rains, the fall amounting to 67·40 inches.

Viewing the statements we see that intermittents are the type of the place, remittents being comparatively few, and continued fever so seldom occurs as hardly to deserve mention.

In regard to season the hot months are the most healthy, and during May, June, and July the fever cases are few and mild in character. April is certainly the hottest month, and although it has a higher number of cases than the four following months, the cases are, as a rule, milder, and it is during this period, also, that the bowel complaints are less numerous, and of less severity; excepting when cholera may happen to prevail, but in July the number begins to rise.

Now what have we during this quarter that is so favorable? There are some circumstances that are not generally thought to be conducive to health. During April, May, and the first-half of June we have a high temperature, an arid baked soil that cracks in huge fissures to the depth of eight or ten feet; all the wells dry, or nearly so, and the water store is at the lowest, the people resorting to the rivers and nullahs for their supply. But after this to the end of July, a decrease of some 12° in temperature occurs, the surface soil is saturated, yet there is no great depth of water in the wells, but with the rivers full and the supply in its worst condition, being contaminated with the surface washings of the whole country. Here is a state of water, that if it be a cause of fever (and some have attributed fevers to impure water), ought to decimate the population, but up to this period the cases are comparatively few.

This same period, taken in regard to bowel complaints, is not so favorable. As respects cholera, two epidemics occurred during the seven years comprised in these statements: that of 1865 prevailed during the months of March and April, and that of 1869 commenced in May and extended over June and July, and the figures certainly bear out the idea that a deficient and impure supply of water may have been a material cause of the disease. But as relates to diarrhoea and dysentery, we find that May and June, with the water at the lowest, have very few cases, but a sudden rise in their number occurs in July. This I believe to be due to the cause, that during May and June the people are driven to use river water, which, although low, so long as it is a running stream, is fairly pure; but in July the river water, as before stated, contains all manner of impurities, and is a prolific cause of these ailments, whilst the wells do not contain enough for the people's wants.

During the next four months we have a steady increase in the number of fever cases until they more than double that of the previous quarter. To what is this owing? We have a comparatively equable temperature, and a humidity of more than three-fourths saturation, with our largest supply of water

in the wells and rivers, and the soil well washed, and saturated to a great depth. Yet the flow of water into the wells is not fast, as it has to percolate to a depth of about 46 feet, which ought to filter it fairly; but looking to the nature of the soil which is black and clayey, and cannot be termed porous, the percolation through it is very slow, the black soil varying from 6 to 40 feet in depth in places.

Here, in regard to temperature and water-supply, we are at our best, yet this is the most sickly period, both as regards fevers and bowel complaints,—to what is this to be attributed? to the greater humidity? Probably, for in August and September the air is nearly saturated, and although in October and November, the two most unhealthy months, the moisture considerably decreases, yet it frequently happens that the rains suddenly stop early in September, and the weather becomes exceedingly sultry and oppressive, and in October, when the rains might be considered as over, we get some heavy showers, and after such late rains, November is sure to be more or less humid and sultry, and the cold weather, as it were, delayed.

After this we have a decrease in temperature and humidity, and a change of wind with a rapid fall in not only fever cases, but also bowel complaints, notwithstanding that the water-supply has been gradually decreasing until we arrive at about the middle of March, when there is again a rise for that half month and in April, which may be due to atmospheric changes, the easterly and variable winds veering round and setting in from the westward. It cannot be due to the increased heat, otherwise the following months ought to be equally bad; but as soon as the dry hot wind has fairly commenced, there is a marked fall in both fevers and bowel complaints, and this although, in May, there is a difference of but four degrees in the temperature, whilst the water-supply has been falling still lower.

Looking at the jail returns for the same period, these statements are confirmed. Here the water is taken entirely from wells that are protected and looked after, and although the supply may decrease during the hot months, it is always ample for all purposes, and the drinking water during the hot and rainy season has always been boiled and strained before being given to the convicts. The prisoners have been well housed and clothed, and not overcrowded; in fact, in better circumstances than many free laborers, yet the periodic variation in health is the same amongst them as seen at the dispensary, and the same has been observed amongst the few European residents. From this it is evident that it is not merely defective clothing, bad food, or water, or housing that is the cause, but some widespread, atmospheric or terrestrial, condition which influences all classes.

The statements do not assist us much regarding the type of the fevers. Tertians and quartans are most frequent during the latter half of the year, and in this respect tally with the quotidians, and the same is the case with remittents and common continued cases: and it is in the tertians and quartans that enlargement of the spleen is chiefly noticed; for my experience is, that it is in those who have had several attacks of ague, commencing as quotidian, and varying into a tertian or quartan, that the splenic hypertrophy is found; while in persons in apparent robust health, exposed to what is termed malaria, and suddenly stricken down, the whole of the internal organs become congested, and the liver suffers as much as the spleen, and I have had several cases terminate in hepatic abscess and not in hypertrophy of the spleen, and am inclined to think that hepatic abscess is a sequel of fever much more common than it is generally thought to be.

I have often been struck with the truth of a statement I heard long ago, and which I believe was made by Superintendent Surgeon Spilsbury, that in India "the new comers suffer most in the hot weather, the old residents in the cold months

but that every one ails more or less during the rains," and I fear the rains are justly credited with our fevers. Heat alone does not produce fever, or we ought to have them most prevalent during April, May, and June, which however have been shown to be our most healthy period. Cold cannot be credited as the cause, for it is the time in which the fever-stricken recover their health, bad water too is mostly met with during our time of best health; but during and immediately after the rains, every second person has one or more attacks of fever. What have we, then during the rains, which predisposes to this disease, and renders the human frame susceptible to its effects? We have an equable temperature varying but a few degrees in the twenty-four hours, and our water-supply is at its best; but we have an atmosphere loaded with moisture, and that cannot carry off the secretion of the skin: the skin, therefore, in full blooded individuals, is constantly bathed in perspiration to the great detriment of its eliminative action, and in the anæmic, this action is almost checked.

It is not a sudden abstraction of heat causing a constriction of the cutaneous capillaries, and a less circulation through them, but an interference with the excretive powers of the skin; and when we consider what is the amount of the organic and saline matters and of watery vapour thrown off by this surface in the twenty-four hours, the throwing of this work, or even a portion of it, on the internal organs, is enough to destroy their equilibrium and depress the nervous system. For, for the proper performance of the nervous functions, we must have a pure blood carrying oxygen and reparative material through its substance; but when one such depurant organ is *hors-de-combat*, it is difficult for the others to take up its work in addition to their own, and hence we soon get an impure state of the circulating fluid, which acts as a depressant on the nervous centres. If it were mere check of skin action, then the cause would be in greatest operation in the cold months, and in cold climates, but it is not so; the heat of the weather at this period maintains a determination to the surface, but as there is no evaporation to carry off the perspiratory fluid, the effect products, which ought to be thrown off, are not; and an impure blood is circulating in the cutaneous capillaries, whilst in the cold weather the determination of blood to the surface is checked, and thus if less blood is circulated through this capillary system it is depurated before it is returned to the internal organs. There doubtless is a greater onus on the internal organs in the cold weather, but it is of blood that has not been circulated through the cutaneous capillaries, and therefore, perhaps, these organs are the better able to purify it, in that it does not contain the noxious material that ought to have been eliminated by the skin.

Dr. Carpenter tells us that the "circulatory fluid contains albuminous compounds in a state of incipient decomposition, composed in great part of epithelium cells, cast out tubes of glandulæ, and in addition urea in no considerable quantity," and that "the skin may be considered supplementary to the kidney in its excretory action." Here we see how it is that the internal organs cannot eliminate the impurities of the cutaneous circulation. The kidneys might undertake the removal of the urea, but the albuminous compounds are already in a state of decomposition, and if carried back to the general circulation, are so much semi-putrid matter introduced; whilst the epithelial cells and cast off tubes of glandulæ remain adherent to and act as a coat of foreign noxious matter on the surface of the body.

In the hot months the skin action is very active, and the atmosphere being dry, evaporation occurs rapidly, and the injurious particles are carried off at once; whilst in the cold season, the circulation through the skin is less, and the internal organs have gradually undertaken the purifying of the diverted quantity of blood. And again the surrounding conditions are

much more favorable, the atmosphere is less oppressive, and contains more oxygen, for the combustion of the nitrogenized effect products to be eliminated by the lungs: whereas in the rains we have a high equable temperature, oppressive from its humidity, no evaporation to carry off the perspiration, and as a consequence the depurating action of the skin materially checked; whilst the lungs are unable to carry off the three ounces or so of additional carbon, as the atmosphere does not give the oxygen necessary for its combustion, or conversion into carbonic acid and water, nor for the conversion of these protein products into uric acid and urea, so that they might be carried off by the kidneys, and, further, this moist state of the air also interferes with the excretion of the watery vapour and other products naturally thrown off by the lungs, and thus there is not merely a check of skin action, but also of the aerating power of the lungs.

I have, in my own person, experienced the extent to which this interference with the action of the lungs can give rise to severe fever. In the month of September, 1870, I was travelling up to the plateau of Pachmari. At night I stopped at the foot of the hill, but being anxious to reach the top early the next morning, I started at 3 a.m., and as I had to travel twelve miles through a thick forest jungle, I clothed myself warmly, but as soon as I was well into the jungle I felt quite a difficulty in my breathing, as if I could not get the air into my lungs, and although (what with the heavy atmosphere and clothes I had on) I perspired freely, yet in the four hours it took me to ascend the hill, I was so oppressed that a severe attack of fever ensued. The weather at the time was particularly fine for September, and the vegetation all green and rank, but not a particle of decaying matter could be seen on the hill side, nor any stagnant pools; nothing but pure running streams, hence there could be no malaria in the common acceptance of the word, as there was no decaying vegetable matters, and my skin was, I won't say, acting properly, but bathed in profuse perspiration; but I was poisoned through the air being so loaded with moisture, and not affording a sufficiency of oxygen to purify my blood in its course through the lungs.

If this be a true cause of the rise and fall in the state of the general health, these remarks apply not merely to the Narbada Valley, but more especially to those frightful epidemics that occur in Bengal, and to all low lying marshy districts, where the inhabitants of necessity suffer from check of the eliminative action of the skin, whilst a high temperature causes a determination to and an active circulation through its capillaries, and shows the great utility of drainage and cultivation and other such like sanitary measures, by which large tracts of country that were once merely hot beds of fevers, have been rendered healthy and habitable; and this also points to some remedies of easy application. We cannot always drain the swamp, nor yet in every case remove our patient from its influence, nor during the rains can we get rid of the damp saturated atmosphere, but we can encourage skin action by warm clothing; and by a frequent change of this keep the skin as dry as possible, and thus avoid the tepid bath of perspiration.

If it then be asked of what use are our antiperiodic and febrifuge drugs, such as quinine, iron, &c.? I answer, as tonics they are invaluable in such cases, as by their action on the nerve centres and circulating organs, they support the system, and enable it to struggle against the depressing action of the poison, and to effect its excretion. They allay the irritability of the nervous system, give tonicity to the blood vessels, and also act on the blood itself, especially the ferruginous compounds giving it oxygen, and improving its quality, and thus give power to the circulation, and effect a salutary influence over the whole organism, and give increased energy to each and every organ to perform its functions.

Statement showing the number of cases of Fevers and Bowel Complaints treated at the Hoshungabad Dispensary from 1865 to 1871 inclusive.

DISEASES.	YEARS.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPT.		OCT.		NOV.		DEC.		TOTAL.	
		Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.
Febris intermittens quotidian. ...	1865 to 1871 inclusive.	1,053	5	1,055	1	1,287	5	1,482	2	901	6	934	...	886	...	1,037	7	1,585	5	2,036	6	1,915	7	1,624	7	15,825	51
Febris, intermittens tertian. ...		31	...	23	...	47	...	112	...	82	...	25	1	37	...	139	...	130	...	90	...	87	...	42	...	845	1
Febris, intermittens quartan. ...		56	...	35	...	127	...	28	...	60	...	75	...	95	...	52	...	139	...	162	...	15	...	36	...	880	...
Total of intermittents		1,140	5	1,143	1	1,461	5	1,622	2	1,043	6	1,034	1	1,018	...	1,228	7	1,854	5	2,288	6	2,017	7	1,702	7	17,550	52
Febris remittens ...		17	...	16	...	10	...	21	1	14	4	37	...	24	1	36	...	41	1	55	2	34	1	85	2	363	12
.. C. continued	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cholera	...	...	...	...	58	13	49	8	432	270	54	4	6	2	4	1	3	1	1	...	...	...	...	...	...	610	300
Dysentery	67	4	103	2	113	1	136	2	109	2	124	2	185	2	181	8	163	6	186	9	186	4	144	2	1,688	44	
Diarrhœa	17	1	38	4	67	6	77	3	40	...	70	2	116	1	79	5	102	1	76	6	76	1	75	1	833	31	
Average rainfall ...	1862 to 1871	0.65		0.44		0.26		0.04		0.37		6.76		15.69		15.03		8.16		0.98		0.50		0.50		Annual average 48.88	
Average mean temperature	...	67.50		77.25		84.50		97.25		93.50		88.00		80.25		81.00		81.50		82.50		78.00		71.00		...	
Humidity per cent.	...	67.0		48.0		38.5		18.5		38.5		59.5		76.5		76.0		77.0		52.0		47.0		56.0		...	
Sub-soil water-level	1870 to 1871	59.9 feet inch		58.5 feet inch		59.1 feet inch		59.9 feet inch		Well dry.		Well dry.		57.9 feet inch		55.0 feet inch		54.0 feet inch		55.10 feet inch		56.2 feet inch		57.4 feet inch		...	
Prevailing winds	...	E.		Variable		W.N.W.		W.N.W.		S.W., W.		W.N.W.		S.W., W.		S.W., W.		S.W., W.		S.W., W.		N.E., E.		N.E., E.		...	

Statement showing the number of cases of Fevers and Bowel Complaints treated in the Hoshungabad Jail Hospital from 1865 to 1871 inclusive.

DISEASES.	YEARS.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPT.		OCT.		NOV.		DEC.		TOTAL.		
		Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	Admitted.	Died.	
Febris intermittens	1865 to 1871 inclusive.	93	...	100	...	98	1	60	...	55	1	83	...	82	...	119	...	158	...	272	...	156	...	111	...	1,387	2	
.. remittens		1	1	1	1	6	3
.. C. continued		2	1
Cholera		13	8	13	6
Dysentery		11	2	3	...	4	...	13	...	2	...	10	2	8	...	19	...	8	...	2	...	24	...	16	3	120	7	
Diarrhœa	15	...	9	5	12	...	6	1	18	3	11	...	18	...	20	...	9	2	6	1	15	...	13	...	151	12		
Daily average strength of prisoners	...	271.87		265.52		261.05		249.66		243.70		249.04		243.82		254.82		240.28		248.25		239.77		256.76		Annual average 257.88		

QUININE AS AN EMMENAGOGUE.

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UNDER the above title Dr. Calthrop has published a case in which abortion resulted from a large dose (5ss.) of sulphate of quinine. Three similar cases have occurred in my own practice during the last nine years, short notes of which may be of interest.

(1.)—Mrs. G. —, aged 18, a strong and healthy primipara, consulted me, in March 1864, on account of quotidian ague of three or four days' duration. After a preliminary purge she was ordered to take 5 grains of quinine three times in the day. After the sixth dose labor pains commenced, and in due course she was delivered of a six and a half months' child.

(2.)—Mrs. —, in July 1869, came under treatment for quotidian fever, which at that time was very prevalent in this district, and of a bad type. She was four or five months advanced in pregnancy, but I was not made acquainted with this fact. I ordered her to take three five-grain doses of quinine every two hours, during the seven hours preceding the expected paroxysm. This was followed by labor pains in a few hours, and abortion of a four and a half months fetus.

(3.)—Mrs. N. —, aged 28, a pale hysterical woman. Had suffered much before marriage from uterine leucorrhœa, and hysterical convulsions. Whilst pregnant with her first child, and after its birth, in July 1870, she had frequent attacks of these convulsions. Her second pregnancy dated from the end of December 1870, or beginning of January 1871. From this time up to the beginning of August she appeared to improve very much in health. On August the 2nd, and again on the 4th, she had attacks of tertian ague. The first was very severe, and second more severe still, being marked by intense headache, vomiting and purging. Bearing in mind the above two cases I withheld quinine, giving biberne and narcotine without effect. On the 5th the intense depressing headache still continued, and on the morning of the 6th the cold stage commenced much earlier and lasted much longer. The headache was intolerable. As she was rapidly losing strength I determined to give quinine a cautious trial, with the full consent of Mrs. N. — and her husband, both of whom I warned of the possible effects of so doing. Two grains of quinine in effervescent saline mixture were ordered to be taken every two hours. The first dose was vomited, but the subsequent five doses retained with the most