sible to compress the aorta effectually while this was done; but still I hoped that the dissection made in a vain endeavour to find the common iliac, might at least enable an assistant to apply efficient compression on that vessel, or on the aorta, during the brief time that would be occupied in clearing out the clots and securing the artery in the interior of the tumour.

ARTICLE III.—*Notes on the Medical Topography of Kussouli, with especial Reference to the Quantity of Ozone at different Elevations, and the Effects of that Agent on Malaria.* By W. W. IRELAND, M.D., late Assistant-Surgeon, H.M. Bengal Army.

KUSSOULI is one of the Simla group of Himalayan sanitaria. It is situated on the first range of hills, on a mountain about 6400 feet high, which shoots up from the plain of Hindustan. The station is upon the top; the body of it is composed of the barracks, bazaar, cutchery, and two station churches, which occupy detached level spots on the west shoulder of the hill. The residents' houses, about sixty in number, are scattered along the ridge to the eastward. The mountain towards the summit is very thickly wooded with pine trees,—Pinus excelsior, and occasionally Pinus longifolia.

The mountain is principally composed of schist, more or less micaceous, and compact in different places, sometimes so arenaceous as to resemble sandstone, sometimes approaching to claystone. The strata vary in thickness and distinctness; they lie with their angles of inclination towards the north side of the hill, but the south side is the most precipitous,[1]—a common feature in the Himalayan chains, in which the elevating force seems to have acted towards the north-west. There are some beds of tuffa and shale; and limestone towards the base of the mountain.

The mean monthly range varies from 42° to 72°. The thermometer is continually sinking and rising again two or three

[1] All the stations of the Simla Himalayan sanitaria, save Sabathoo, rest on rocks of micaceous schist. The mineralogical composition of the rocks in Sanauer resembles closely that of those of Kussouli. They are principally of mica schist, often coloured red by hæmatite, so abundant as, in some places, to increase perceptibly the weight. Specimens of these washed with water give the reaction of salts of iron. Cases of miasmatic fever do not occur among the inmates of the Lawrence Asylum at Sanauer, if we except those who have brought the disease up from the plains. This is another argument against the theory of Dr Heyne, that malarious fevers are caused by the presence of iron in the soil. Indeed, all micaceous rocks must contain iron, mica being an aluminate of iron, combined with bases of magnesium, sodium, or potassium. Sabathoo, which is built upon rocks of calcareous formation, is more subject to fever than either Sanauer, or Dugshai, which last hill is not composed of sandstone, as stated by Dr Chevers (A Brief Review of the Means of Preserving the Health of European Soldiers in India, Part II., by Dr Norman Chevers), but of the same schistose rock which prevails at Kussouli and Sanauer.

degrees. The sun is very powerful out of doors; for instance, as late as 14th October, at three o'clock, the thermometer stood at 101°, but in the shade it was 28° lower. The annual rain fall is about seventy inches. During the rains the column mounts rapidly by three, four, six, and sometimes as much as ten inches, at a time. Save during the rains, the air is almost always dry and clear.

In the year 1859, being a resident on medical leave at Kussouli, my attention was turned to the subject of ozone in the atmosphere, and I determined to test the conjecture that ozone occurs in greater abundance at high than at low elevations.

Chemical Properties of Ozone.—But, before going further, it will perhaps be prudent to put our readers in mind of the present state of our rapidly accumulating knowledge of ozone. It is an allotropic form of oxygen produced by the decomposing action of galvanism or electricity on common air or oxygen gas, or by the oxidation of some substance which has a strong affinity for oxygen, such as phosphorus or granulated zinc. If phosphorus be burned in oxygen gas it oxidises, and the remaining oxygen is found to possess certain very marked properties. Its specific gravity, according to Andrews and Tait, is above four times greater than before, and its chemical affinities are powerfully increased. Schönbein considers that the oxygen becomes "polarized." He thinks oxygen exists in three forms; neutral or common oxygen, positive active oxygen, and negative active oxygen. The two last are generally known by the common name of ozone; but though both possess in an intensified degree the active forms of oxygen, they have different properties. In a paper in Buchner's Repertorium,[1] Schönbein has shown that oxygen in its three forms of neutral O, positive active ⊕, and negative active ⊖, enters into three several combinations with gallic acid, pyrogallic acid, hæmotoxyline, and aniline. He proposes to give the name of antozonides to the positive active class of compounds, one of which has actually been found in nature, and the name of ozonides to the negative active set of compounds.

Ozone exists in the atmosphere in a proportion of 0·01 to 0·002 of a milligramme in 100 litres of air, according to Zeuger. It is scarcely necessary to describe the common way of detecting its presence, by the reaction it gives upon paper impregnated with a solution of starch and iodide of potassium. The decomposition of the iodide of potassium sets free the iodine, which produces its characteristic colour test with the starch. The deepness of the hue is believed to furnish an approximative test of the quantity of ozone in the air; and a scale of colours, on the same principle as a cyanometer, has been prepared in order to help one to compare and register the degrees of discolorization.

The quantity of ozone has been found to vary naturally at different times and in different places. It is greater during the

[1] Band x., Heft 2. 1861.

night than during the day. The temperature of the air, and the amount of ozone it contains, generally speaking, stand in an inverse ratio to one another, as also do a high barometer and a highly coloured ozonometer.

Some regard electricity as the principal source of atmospheric ozone; while others consider that, in addition to this, ozone is produced by the oxidation of the organic material of the vegetable world.[1] Its production in the atmosphere, as well as in the laboratory, seems generally to be accompanied by that of peroxide of hydrogen (HO_3). Ozone, or a compound of it, has been found in the sap of some fungi, and in vegetable oils, such as turpentine, coco-nut, linseed, etc. It has powerful effects on most organic substances. Blood in contact with ozonised air is completely oxidised with the production of carbonic acid and water; caseine is changed to albumen, on which last ozone has an antiseptic effect;[2] and it changes indigo to isatine. That such an agent should have powerful effects upon organized beings is at first sight more than probable.

Disinfecting Properties of Ozone.—As a general rule, oxidising compounds, such as those of chlorine, calcium, manganese, and nitric acid, are also disinfecting agents. It seems almost certain that ozone plays an important part in disinfecting the air and destroying the different organic gases which occasion malaria and disease. The air itself is a disinfecting compound, as every one recognises who keeps his vaccine matter in air-tight tubes; and the ozone the atmosphere contains must possess these properties in an increased degree. Schröder found that putrefaction would not go on in ozonised air; white of egg kept in it for thirty-eight days showed no trace of alteration. Moreover, there is reason to believe that ozone is the active principle in several powerful disinfecting compounds. The quantity of ozone mixed in the air, however, is normally so small, that in place of destroying mephitic compounds, these generally cause its disappearance. As is well known, ozone cannot be detected in the vitiated air of a large town like Manchester. Still we may expect the presence of an increased quantity of ozone to destroy a larger proportion of zymotic matter in the air.

I do not know of any direct proof that it destroys the malaria of miasmatic fever (intermittent and remittent): the two, that is the ozone and malaria, can co-exist: of this my experiments have left no doubt. I think it very probable, however, that ozone acts in hastening the destruction of this form of malaria.

From the experiments of Surgeon Baddeley of the Bengal Artillery, we know that the occurrence of dust storms is attended by the evolution of electricity, of low intensity, but remarkable

[1] "Bei der Oxydation der Organischen Stoffe der Ackererde bildet sich Ozon."

[2] Liebig und Kopp Jahresbericht der Chemie, 1858–59, and Annal der Chemie und Pharmacie, Bd. cx. p. 86.

quantity. These dust storms, then, must produce a very considerable increase in the atmospheric ozone. Mr Baddeley found "that on days when the air was dry, electrical, and gusty, from the passage of whirlwinds," solutions of starch and iodide of potassium, in an *open* cup, became blue in a very few minutes. Here we have an extra amount of ozone in the air. Does this, then, diminish the force of malaria? Such is certainly the general impression, both amongst the natives and European medical men. Mr Baddeley remarks: "I believe that dust storms have a salubrious tendency, and diminish diseases arising from malaria; and your own experience must have impressed you, as it has me, with a conviction of their invigorating effects." A regular series of observations on the number of hospital admissions, after dust storms, would be of great value. Having no access at present to Indian medical literature, I am unable to find out whether any such exist. In Mr Baddeley's book,[1] some notice is taken of indications of the absence of electricity in the air, followed, we may infer, by a diminution of ozone, from August till November 1850, during which time malarious diseases prevailed amongst the troops. Putting these facts together, there seem strong grounds for suspecting that dust storms, which are often very limited in their area, do not simply destroy miasmata by circulating and cooling the air, as Mr Baddeley is inclined to think. Circulation of the air sometimes diffuses the malaria instead of diminishing it, and cooling of the air (as during the night) increases instead of diminishing the power of malaria. But, perhaps, it would be necessary to have more definite observations before arriving at any settled conclusion on the matter in hand.

A paper upon ozone having attracted my attention, I determined, as already said, to try some experiments with iodide of potassium, pure enough to be used for photography. After one or two trials, Is ucceeded in making some very good ozone test-paper. The want of an ozone scale, of course, did not affect the relative value of my experiments as compared with one another, but only as compared with the half dozen of ozone scales then in vogue. I kept the papers carefully from the air, and compared them continually with one another, and afterwards with an ozone scale, when I returned to Europe.

I had the Government instruments for meteorological observations, but they were all broken, save four thermometers and a rain-gauge. I was particularly sorry that the hygrometer was not in working condition. I had six points of observation,—1. My own house, about 6000 feet above the sea; 2. The top of the Devi Ka Karor, on the east side of Kussouli, perhaps 6400 feet high; 3. A station at Gharkel, on the road to Sabathoo, about 1000 feet below

[1] Any one interested in the subject ought to consult the work of Mr Baddeley, "Cur spirent Venti," or a Treatise upon Whirlwinds. It is unnecessary to praise observations which have called forth the emphatic admiration of Faraday.

my house; 4. On the flat open hill, about 1500 feet below the hospital; 5. One near the toll-house, about 3000 feet high; and 6. Lastly, one at Kalka, at the foot of the hill, about 1000 feet above the level of the sea. Four men were employed to take the specimens of ozone paper to these points, and bring them away at regular intervals.

Before giving my results, I must repeat, Kussouli is thickly covered with pine-trees, and in some places overgrown with cannabis, which emit ethereal oils known to cause the discolorization of ozone test-paper. I tried some experiments to test this fact. Both pine and cannabis had a visible effect,—moisture alone seemed to have the same, only in a less degree. If we remember that moisture is always greater in the terai, at the foot of the hills, than at the top, the derangement will be thus somewhat remedied,—the effect of the exhalations from pine-trees at the top of the hill counterbalancing the effect of moisture at the foot. The station No. 2 was made at a place as clear as could be found from pine-trees; Nos. 3 and 4 were also almost entirely so. I expected to find the quantity of ozone greatest at the highest elevation, and diminishing steadily as one descended, but soon saw that facts would not bear this out. I had only the first four stations then. In consequence, I determined to try a lower elevation; but even here the results were not so trenchant and invariable as I expected. The average, however, stood as follows:—The quantity of ozone was greatest at point 4; then at house (1); then at 2; then at 3; (these three last were pretty close upon one another;) then came point 5; and then the one at Kalka (6), lowest of all.

This was during the rains, when the air was full of clouds, which rolled against the top of the hill, and would plunge the whole station in obscurity for an hour or two. The maximum of ozone ever obtained was at my house during a thunder-storm,—a coincidence that was not always made out, though thunder was very common at that season.

So far my results agree with those of Dr de Pietra Santa,[1] who, by comparing the quantity of ozone at Paris, Versailles, and Eaux Bonnes, in the Pyrenees, has arrived at the conclusion that ozone is most abundant at high elevations. I arrived at the conclusion that the atmospheric ozone increases in quantity up to a certain point above 4000 feet, and then diminishes. I was confirmed in this idea by two observations made in another locality near Simla. The result of these experiments was communicated to Government in a sanitary report, sent in 1859 by Dr Bell, 93d Highlanders, then in medical charge of Kussouli. They were also communicated by me to Dr H. Bruce, superintending surgeon of the Sirhind Circle. The observations date from the 30th of July to the 12th of September 1859, when the rains ceased. On the cessation of

[1] His observations were made July 1861, and communicated to the Académie des Sciences on 27th January 1862.

the rains, the results showed a prompt alteration: the quantity of ozone increased at the lowest station No. 6, remained much as usual at No. 5, and began to diminish in the four higher ones. The average results from the 12th of September to the 6th of November were as follows:—The quantity of ozone was still highest at No. 4; then slightly less at No. 2, which stood a little above 6 and 3 (these two last were almost equal). Below them came No. 5, and No. 1 stood lowest of all; but, on removing my house on 1st November to a locality very thickly overgrown with pine-trees, it rose considerably. Perhaps the larger amount of ozone towards the top of the hill during the rains, was the result of the electrical disturbance caused by the presence of so many clouds. When they passed away, and the air became dry and clear, the source of new ozone would also disappear; but at Kalka the lower regions of air would be supplied by the oxidation of the immense quantity of vegetation produced during the rains, which oxidation would now go on rapidly under the influence of increased sunshine and diminished moisture. The quantity of ozone continued diminishing at the first four points till the 20th December, with one rise from 11th to 13th November. At the same time the weather was clear, dry, and bracing, and there was a fall of snow in the beginning of December which lay under the trees for a fortnight. The health of the soldiers continued improving, while the quantity of ozone was diminishing.

On the 25th December, I reached Umballa, a station forty miles from the hills, where a month's observations showed that ozone was more abundant there than it had been at Kussouli since the end of September.

Mindful of several sources of fallacy in my observations, I have only tried to give those results which rise above the mere variations of accident.

I shall only notice two remarks on the connexion between the health of the station and the quantity of ozone. At one time, about the 20th of October, ozone was very low; there were but two men in the hospital; but three cases of sciatica came in, and several cases of fever occurred amongst the natives. On the 23d, the quantity of ozone showed marked increase, and all the patients recovered.

The only other sudden decrease in ozone (9th November) was followed by threefold increase of patients in the hospital, and by the prevalence of rheumatism and influenza, which disappeared in a few days. I am aware that influenza is believed to follow an increase of ozone,—certainly not under all conditions. There is no influenza after dust storms in India.

At first it was supposed that certain volatile oils, especially that of turpentine, possessed the property of producing ozone; but this view has now been generally abandoned. It is generally believed, however, that they contain a not yet isolated compound of ozone,

which certainly possesses almost all its active properties, and notably its oxidising ones in a high degree. Berthelot found that turpentine oil absorbed sixteen times its volume of oxygen, and was still absorbing more. This absorption goes on more quickly in the sunlight than in the dark. Berthelot is of opinion that the absorbed oxygen exists in the turpentine in three forms: one fifth in that of common oxygen; one half in that of active oxygen, probably in the form of a not separable compound; and, finally, in that of a resinous combination of ozonised oxygen, which, according to Schönbein, is an antozonide.

It is easy to perceive that, on a hill densely covered with pine-trees, under a temperature above 100° in the sun, the oxidation of volatile oil and the production of ozone must be actively going on. My experiments prove that, at a temperature from 75° to 82°, a piece of ozone test-paper, nailed to a pine-tree, showed sensible discolorization in half an hour, which was greatest on the side next the bark. One could easily note the higher degree of discolorization, by comparing it with that of a piece of the same paper nailed to the post of the verandah about six feet off. By experimenting on pieces of pine-wood bark and leaves, and specimens of Cannabis sativa in closed bottles, I found that they had a decomposing effect upon test-paper; that this went on actively in the sunlight, and almost ceased in the dark, unless kept up by artificial heat. Moisture alone would cause a certain, but fainter degree of discolorization, and only acted in the sun's rays. In ten experiments made in Wiesbaden (the others were in Kussouli), I found that the quantity of ozone was constantly greater at an elevation of about 200 feet above the valley where the town stands, than in the suburbs of Wiesbaden itself; and the quantity was invariably higher still in a pine plantation about the same elevation on the other side of the hill. This was in the beginning of the month of February 1862. I found the quantity of ozone much diminished in the pine plantation during frost.

The number of trees which diffuse ethereal oils is very considerable; and perhaps it is owing to the oxidising properties volatile oils, so common in the vegetable world, are known to possess, that we may explain the action of trees thickly planted round a station in arresting malaria, especially that of intermittent fever. Of the nature of this, as of every thing else included under the head of malaria, we know very little. It is, however, certain that the air is generally the vehicle for its diffusion, and that we are possessed of some available means of limiting the area in which it exerts its morbific activity. It is well known to be destructible, and is probably decomposable. Malaria, in general, is not widely diffused from its place of origin: three miles' radius is considered to be a sufficient barrier between a cantonment and irrigated lands. A belt of trees interposed between an inhabited country and a malarious district has a well-recognised influence in saving the latter from

fever; and cases are on record where the removal of a wood has caused malaria to appear in a place previously free from its ravages. A writer on the sanitary condition of Peshawer, in the Calcutta Review, seems to believe that this property is owing to some power the trees have of attracting and holding the malaria round about them,—a notion which has led him to prescribe that all the trees within a cantonment should be cut down,—though some treeless cantonments, *e.g.*, Mean-Meer, possess a notorious character for miasmatic fever. Does it not seem more probable that this oxidising power of trees diffusing ethereal oils has, like other oxidising agents, a powerfully disinfecting effect? It has actually been noticed that pine plantations afford protection from the malaria of intermittent fever.[1] I imagine that the ozone acts upon malaria by oxidising it slowly. Turpentine has been long used in India as a disinfecting application to putrefying wounds; and ozone is abundant in coal-tar, which has recently been so strongly recommended by the Académie des Sciences[2] as an application to putrefying wounds; it has been used for cleansing the abattoirs and fosses d'aisance of Paris. In these latter situations the reappearance of ozone has been taken as a test of the success of the disinfecting process,—the coexistence of mephitic exhalations and ozone in the air being considered impossible.

There are localities in India where it is death for a European to spend the night; and there are even military stations where malaria, that lasts only for a few weeks, kills our soldiers by the score, prostrates regiments at once, and invalids whole companies. Could a disinfecting preparation of turpentine, or coal-tar, used at night in the sleeping-rooms, diminish or neutralize the malaria? How many valuable lives might be saved if we could answer this question in the affirmative! A clump of pine-trees would then be worth a forest of cinchonas.

Dr Wood mentions[3] an extraordinary and very important fact in relation to miasmata,—"These effluvia are neutralized, decomposed, or in some other way rendered innoxious, by the air of large cities. Though malarious diseases may rage around a city, and even invade the outskirts where the dwellings are comparatively few, yet they are unable to penetrate into the interior; and individuals who never leave the thickly-built parts almost always escape. This fact is notorious in relation to the city of Rome; and we have seen it abundantly confirmed in the larger towns of the United States, in the neighbourhood of which these diseases have prevailed. What it is in the air of the city which is thus incompatible with malaria

[1] Professor Wood's Practice of Medicine, vol. i., part ii., chap. i.

[2] Comptes Rendus à l'Académie des Sciences, Sept. 19, 1859. M. Burdel de la Poudre Corne et Demeaux considérée au point de vue de l'hygiène publique. The composition of this powder is 3 parts coal-tar to 100 of plaster of Paris or river sand.

[3] Practice of Medicine, vol. i., part i., chap. ii.

is unknown; but very probably it is connected with the results of combustion, for the fire and smoke of camps are asserted to have had the same effect; and I have been assured by persons inhabiting miasmatic districts of country, that they have been able to protect themselves against the poisonous effects by maintaining fires in their houses during the sickly season." This is just what one could expect, assuming our hypothesis to be correct; combustion would evolve the ethereal oils contained in the wood or coal, and would thus produce ozone[1] to decompose the miasmatic effluvia.

In Germany, it has been observed that in districts where pine forests are abundant, bronchitis and rheumatism are not so common as elsewhere; and Professor Albers of Bonn regards it as certain that patients suffering from these disorders derive benefit by removing to such localities. Ozonized cod-liver oil, the reader must know, has lately been strongly recommended in phthisis.

If this hypothesis could be further confirmed, then trees emitting ethereal oils, especially the coniferæ, would be the fittest to plant round a station; and all stations and sanitaria in India ought to be so protected. They might also be of much service in our intra-urban parks. Of such trees fortunately there is no lack.

In our hill stations we do not escape the influence of intermittent fever, and occasionally of cholera. Sir J. Ranald Martin, in his letter to the Chairman of the Court of Directors, remarks,—"That while the hill climates are permanently serviceable against the malarious fevers of the country, their influences in conducing to the cure of these and other diseases is limited in extent,—the soldier being troubled with relapses of his disorder on descending into the plains, unless kept in the hills for a long time." And how is this? Simply because here also the malaria still exists, though in a weakened form. Some hills are on the first range, and are thus exposed to the full influence of the malaria of the terai; and all, however far into the hills, are surrounded by deep and narrow ravines, which receive the decayed vegetation from the hills above, upon which the sun beats furiously. Ever moist and green, they are mere nests of malaria. Hence, even at Simla, endemic fever exists; and on one occasion it was noted that it was much more prevalent there after a number of trees on the side of the hill had been cut down.[2] But how could trees hanging on the shelves of precipitous rocks detain malaria by any species of attraction? Are we not driven to conclude that they diminish the force of the poison in the air by the decomposing tendency of their emanations?

We shall find an equal difficulty in supposing that trees absorb the malaria through their leaves. The leaves could only absorb what was in contact with their own surfaces; and this, in the case of the needle-leaved coniferæ, would be most insignificant. If the miasmata be at all diminished by absorption, they are much

[1] That it actually does so can easily be proved by experiment.

[2] Dr N. Chevers, *op. cit.*

more likely to be diminished by the absorbing power of the turpentine oils. Some of our hill stations, Dugshai for example, are not planted with trees; I believe the trees were planted at first in Kussouli merely to afford a deep shade from the sun; but though Dugshai is situated on the second range of hills, and though the worst cases of every kind naturally go to Kussouli, which is nearest to the plains, the mortality in Dugshai is greater than that of Kussouli, being 42·892 in the 1000. That of Kussouli is 40·373. But I approach the statistics of the hill stations with the greatest distrust.

The regiments sent to the hills are generally exhausted by stress of service, or unusual amount of sickness; and the number of invalids is swelled by drafts of the worst cases, often badly selected, from the hospitals in the neighbouring stations below. The regiments are never allowed to remain long in the hills, and are often sent down to the plains for drill during the cool season, which in the hills is the healthiest part of the year. Hence the number of deaths is very considerable; but they are generally the result of disease contracted in the plains. It will not seem surprising then that the actual mortality is greater in Kussouli than in many stations in the plains of India.

One cannot even venture to compare the statistics of one hill station with those of another. One sanitarium gets a number of invalids from Peshawer, their constitutions utterly ruined by the remittent fever there. Another gets the comparatively light cases from Meerut or Bareilli. Of course the mortality of the first is much greater; but one might as well compare the average mortality in Baden-Baden with that of Madeira.

Kussouli is regarded as on the whole a good sanitarium. In common with all those of the Simla group, it is visited almost every year by what is called hill diarrhœa, a disorder which is by no means confined to the higher ranges of hills, as some seem to imagine, but is very prevalent among the hill men in the valleys, who seem perfectly at a loss how to treat it. It is most probably of malarious origin.

One thing we may note in the medical history of Kussouli, which is pretty correctly given in the work of Dr Chevers, that it is steadily improving in salubrity.[1] In 1859 it was selected as a

[1] The average mortality from 1844–55 to 1857–58 stands thus:—56·00; 56·122; 44·181; 69·519; 15·152; 21·439; 50·179; 24·550; 16·313; 43·551 (year of siege of Delhi, when many wounded came to Kussouli); 35·225.

The mortality was at first much swelled by hill diarrhœa; in 1850–51, there were in H.M. 60th Rifles thirteen deaths from bowel complaints. The regimental surgeons seem to have been at a sad loss what to do, for we hear that the springs at Kussouli, on the Kalka road, were abandoned, "the water being considered unwholesome from being much impregnated with lime." This, however, is not the case. The water from the Kalka road, tried with oxalate of ammonia, yields only a trace of lime, much less than the Edinburgh water, which is thought very wholesome. It is derived from a part of the hill not polluted by human habitation, and is separated from the drainings of the bazaar by a descending ridge of rock which turns them another way. The water is

sanitarium for cases of all descriptions from the Punjaub, and the results were highly favourable. From the 1st of March to the 30th September 1859, there arrived 242 invalids; 140 recovered, 35 were invalided, 5 died, and 63 were remaining on duty. Of these last, 37 were to go down on the 1st of November. Some had recovered, and it was considered unadvisable to subject the rest to the cold of winter. Dr Bell, in charge of the depôt, states that he had not seen a single case of hill diarrhœa, as described, that season. There were nine cases of ordinary diarrhœa admitted into hospital, all very mild, and above fifty of sciatica—the sequela of ague. The fever cases were slow in mending, and subject to relapses. Two of the deaths were from hepatic abscess, and three from the exhaustion of miasmatic fever contracted below.

One might be disposed to assign the improved salubrity of the station to improved accommodation; but in Kussouli, in 1859, when the statistics were so good, the accommodation was never worse, many of the men were actually crowded into the commissariat go-downs, owing to the burning of the barracks in the winter of 1858. The season was not an over healthy one, and the 93d Highlanders at Sabathoo suffered severely from fever.

Most stations in the plains improve in salubrity after being a few years established. This is easy to account for. Planted within a few miles of a native town, they are exposed to the putrid emanations which spring from the border of filth surrounding every Indian city; but as the cantonment laws come into force, and the land becomes cleared and drained, miasma decreases along with the annual mortality and percentage of sickness. With a hill station the reverse is the case. It is planted upon the hill-top, on a site occupied perhaps by only a dozen of huts, and the presence of a European regiment brings a large population of natives, who accumulate dirt and fifth in every cranny of the hill. In the case of the cantonment the ground gets always cleaner; in that of the hill sanitarium it becomes continually dirtier. The improvement in the health of Kussouli, then, cannot be attributed to improved cleanliness.

May not this continual improvement in the health of the sanitarium be owing to the growth of the pine trees which were planted when it was first established, have been most jealously guarded, and now have grown so high and thick that they overspread the whole station. The scientific reader will, I think, admit that this hypothesis is one which, at least, is deserving of the fullest examination and experiment.

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still used by the natives for drinking. There are strata of alumnaceous slate above the cistern, which might have been mistaken for limestone. The place from which the water for the cantonment is now most unfortunately drawn is on the other side of the hill, and into it half the dirty water and drains of the cantonment must flow. The deaths from bowel complaints, 1851–52, were 27; but next year they were only 2 out of 194 cases of diarrhœa, and are becoming less formidable every year. I have no returns later than 1859.