

atmosphere will yield; and exhaling carbonic acid gas, watery vapours, and noxious effete matter from their lungs and pores. And yet these are the unfavourable circumstances (aggravated by scanty innutritious food, and water which is often poisonous in its impurity), under which numbers of the poorer classes of our Indian towns and villages strive for existence.

Few "know how they live, how life in them,
Still feebly lurks from morn to ghastly eve,
From eve to haggard morn."

It must not, however, be supposed, that poverty and misery alone are the causes of the insanitary state of these habitations. The following graphic description, which appeared in the *Calcutta Review*, and has been reprinted in Hunter's *Statistical Account of Bengal*, is a proof to the contrary :

"The dense mass of vegetation in which all Bengalis delight to shroud themselves, and which encircles the rich landholder's palace, as well as the peasant's hut, is everywhere more or less productive. It is composed of the materials for food or for building—the cocoanut, the bamboo, the jack tree, and the mango. There may be seen the slender stalks of the betel tree and the towering stems of the cocoanut above them, their long arms waving in the breeze; on the other side, probably, a thick garden of plantains, that curious link between the vegetable and the timber; in the back ground an underwood of wild cane, twining itself round everything of firmer bulk; and a little further on, an undistinguishable mass of thorn, creepers, and underwood of every shade, length, and denomination. The husbandman must have his fruit trees and his bamboos, which yield him a return for no

expenditure of labor but that required for gathering or cutting—his protection for the womankind, and his shade against the fierce sun of April and May. If he attains these primary objects, he is content, no matter how much miasma may be exhaled from the decaying vegetation, how many diseases may lurk in that fair but deceitful mass of green foliage, how many reptiles and venomous snakes may be concealed in the unwholesome shades which surround his paternal inheritance. The sun and the gaze of the passing neighbour must alike be excluded. Grant him this, and he will endure with stoical fortitude the periodical fever, the steamy heat of the rains, and the fetid water which stagnates in the pools, whence he has dug the materials for his homestead site (bhita), and which never feels the influence of the breeze and the light.”

Dr. Julian Jackson, when Sanitary Commissioner of Bengal, reported: “It is greatly to the want of adequate protection from the cold at night, as well as against the glare of the sun by day, that the predilection of the people for encouraging the growth of underwood and jungle round their houses is due. There is no doubt that it is a source of warmth, protecting the people at night from chill winds and currents of air; but when disease appears it obstructs the very ventilation that is needed for its dissipation. The great objection to jungle is, that it is invariably used for purposes that pollute the air, such as defaecation, deposit of refuse, &c. Bamboo jungle is absolutely necessary for repairs and constructive purposes, but, in the absence of all attempts at sanitary regulation, is invariably used as a village latrine. I know of no sanitary measure that excites the villager’s

indignation to such a pitch as the removal of jungle ; and have frequently heard them attribute the outbreak of disease among them to this cause, alleging that the exposed soil 'gave off' noxious emanations to the sun's rays, which, considering that such sites had been the receptacle for filth of all kinds for many years before till the soil was thoroughly saturated with organic material, was probably true enough."

Another source of air pollution is the practice which obtains throughout Bengal, of digging pits from whence to take earth to raise the floors and plaster the walls of the huts. These eventually become the *anstakoor*, or the general cesspool, receiving the filth and ordure of the household, the garbage of the cookroom, and the draining of the cow-stall, and remaining more or less full of water according to the season : rank vegetation springs up in them, dies down, and rots in regular succession. They thus become foci of foul gases and malarious exhalations. Legislation has provided for the prevention of this form of nuisance ; and in spite of the obstinate opposition of even some of the most enlightened and learned natives, who regard such measures as interference with the sacred rights of private property, Municipal Committee-men are awakening to the necessity, in the interests of the people themselves, of suppressing the practice.

A fruitful source of aërial impurity is the foul vapour arising from drains, sewers, and privies, especially that most objectionable institution known as the *Sundaish*, or well-privy, which was till lately, and still is, in many places the universal accompaniment of every native dwelling of the better sort. In Calcutta and the suburbs, until within the last few years, there were one or more

in every brick-built native house throughout the Municipalities. The following description of a privy, taken from the Sanitary Commissioner's report, is not an exaggeration of what used to be the universal state of things:—

“The private privies in general use are demi-upper-roomed ones, on the upper floor of which there are two holes on which the people sit and allow the excrement to fall into the room below, where it is allowed to accumulate. Some of them are cleaned out every two or three months, others again annually. In the rainy season especially, the filth is poured down on the roads and into the drains after heavy showers of rain.” Add to this that generally there was a well or pit sunk in the floor of the lower compartment, and that the filth in that case was never removed, and we have a picture of the well-privy.

An instance which came under the writer's notice a few years ago, will illustrate the subject as well as give some idea of the apathy with which natives of this country, even men of education and enlightenment, regard the existence of such evils. A native of wealth and education, a member of the native Bar of the High Court, was the owner of a range of tenanted buildings in a principal street of the town. There were forty tenants, who used a range of privies built over a well and common to the whole premises; this *cloaca* was never cleansed, but the filth accumulated till the well was filled, *then* the lower compartment of the building; when the weight of the foul fermenting mass burst open the door and overflowed into a pond in rear of the premises. The privy and pond being in rear of the

building enclosed within high walls, the conservancy officials were ignorant of its existence till cholera breaking out in the house the cause was soon revealed. It is perhaps not so much a matter for surprize that the owner, who by the way regularly realised from his tenants the cost of cleansing, should not have seen to the cleanliness of the place; but the conduct of the tenants (many of whom were educated clerks and schoolmasters), who paid for the work but never troubled themselves to see that it was done, or complained of the neglect, is a significant proof of the carelessness displayed by natives of this country in regard to this fearful domestic danger. Talking once to a learned native gentleman, a savant with an European reputation, on this subject, he said, "I have had an uncleaned well-privy in my house for twenty years, and no harm has resulted."

Now it is a well-known fact that fecal matters, when in a state of decomposition, give forth carbonic acid, nitrogen, sulphuretted hydrogen, light carburetted hydrogen, and ammonium sulphide, besides extremely offensive odors, mainly due to organic matter,—that is to say, they produce every possible element of atmospheric impurity in their greatest intensity. But besides the mere fouling of the air, which in its vitiated state predisposes to disease, must be considered the probable diffusion of what are called filth diseases,—*viz.*, cholera, diarrhoea, enteric fever, &c.; and which it is believed may be contracted by inhaling the effluvia arising from the dejecta of persons suffering from these complaints, and even from filth in a state of putrescence, so much so that, in America, the name "nightsoil fever" has been given to typhoid fever, so directly has night-

soil improperly kept been proved to be the cause of this disease. A case reported by Dr. Carpenter proves the potency of an atmosphere charged with putrescent emanations in rendering the system liable to the attacks of zymotic diseases of various kinds. A manufactory of artificial manure existed immediately opposite Christ Church Workhouse, Spitalfields (London), which building was occupied by about four hundred children, with a few adult persons. Whenever the works were actively carried on, particularly when the wind blew in the direction of the house, there were produced numerous cases of fever of an intractable and typhoid character; a typhoid tendency was also observed in measles, smallpox, and other infantile diseases; and for some time there prevailed a most unmanageable and fatal form of aphthæ of the mouth, ending in gangrene: many deaths occurred. The proprietor of the factory was compelled to close his establishment, and the children returned to their ordinary health. Five months afterwards the works were recommenced. In a day or two subsequently, the wind blowing from the manufactory a most powerful stench pervaded the building. The night following forty-five of the boys, whose dormitories directly faced the manufactory, were again suddenly seized with diarrhœa, while the girls whose dormitories were in a more distant part, and faced in a different direction, escaped.

The manufactory having been again suppressed, there was no subsequent return of diarrhœa.

Well-privies ought to be abolished wherever found; the fecal matter contained in them should, if possible, be removed; but as this is often a difficult and dangerous operation, their contents should be disinfected by

the addition of chlorine, ferrous sulphate (green copperas), sulphate of zinc, and sulphate of iron, or what is largely used by the New York Disinfecting Corps, a mixture of dead oil and copperas (impure carbolic acid and protosulphate of iron)—(Buck. II, 413); and the well then filled up completely with dry earth, well rammed down; the mouth of the well should then be bricked over with good lime and soorkee mortar and well-burnt bricks. Whatever disinfectant is used, it must be freely employed, at least a pint of strong solution to each cubic foot of the contents of the well-privy. Fecal matters should be regularly and carefully removed from privies daily, unless the pail system, known in France and England as the *Système Goux*, be adopted, in which case removal every sixth or seventh day will be sufficient, except in cases where there is cholera or enteric fever in the house, when the excreta should be *disinfected* and removed daily. Privies and privy vaults should be regularly whitewashed with fresh lime and chloride of lime, or Macdougall's powder sprinkled on the floors, seats, and drains. After the occurrence of cases of disease, they should be further disinfected, by burning a small quantity of sulphur in the lower vault. Whether the daily cleansing or the six-day pail system be in force, constant supervision and inspection is necessary to ensure regularity and thoroughness of cleansing. Native householders cannot be depended upon to bring to notice in due time neglect on the part of the nightmen, though they are ready enough, at least the educated portion of them, to rush into print and ventilate real or imaginary grievances in the columns of the English and vernacular papers.

CHAPTER V.

“ The hollow ground ;
Being loose, unfirm with digging up of graves.”

Shakspeare.

Graveyards, especially those used by Mahomedans for the burial of their dead, are fruitful sources of the evolution of noxious gases, such as carbonic acid, phosphoretted hydrogen, ammonia, and sulphuretted hydrogen ; and are distinctly inimical to health.

Dr. Wilson says :—“ According to the evidence summed up in the Report on Extramural Sepulture in 1850, the vapours given off from thickly-crowded graveyards, if not actually productive of disease, do certainly tend to increase the sick and death-rate of the immediate neighbourhood.”

It would be idle and presumptuous for me to attempt to prove what the effects of effluvia from putrescent animal matter are on healthy subjects ; the offensiveness of smell is itself evidence of its deleteriousness. If then the evil is admitted and legislated for in Europe, where bodies are encased in coffins, and buried at a considerable depth, how much greater must be the mischief in this country, when we have bodies merely wrapped in a cloth and placed frequently barely three feet underground, and

where the earth-covering is again greatly reduced in thickness by the Mahomedan practice of placing a platform over the corpse;—and this in a country subject to the intense heat and heavy rains of the Tropics. Here there is not time for that *slow decay* of “the poor remnants of mortality,” by which the elements of organic matter are slowly oxidated or united to the oxygen of the air. On the contrary, the decay passes quickly into putrefaction, and putrid smells, with all their attendant evils, arise from the grave and vitiate the atmosphere.

And here it will not be out of place if we consider what is *putrefaction*. *Tidy* defines it to be “a spontaneous change common to all nitrogenised organic bodies when exposed to the air, whereby they are resolved into new and simpler products. The action is accompanied by the evolution of unpleasant gases, which are, for the most part, compounds of sulphur and phosphorus. It differs from *fermentation* in that *unpleasant* products are evolved, as *e. g.*, in the decomposition of a dead body. Moreover, a putrescible body is always a nitrogenised body, which, at a certain temperature, in contact with air and moisture, decomposes, and then becomes capable of acting as a ferment.

“Moreover, like fermentation, putrefaction is always accompanied by the development of certain minute living organisms, fungi, and infusoria.”

The conditions necessary to putrefaction are air, moisture, and warmth. The presence of the first is necessary only at the commencement of the process. When putrefaction* has once fairly commenced, it continues independently. A perfectly dry body does not putrefy. This is exemplified by the curious dried Indian

corpses found in large earthenware jars, near Campos, in the Brazils, and by the dead monks at Malta. Warmth destroys cohesion, and thus aids putrefaction. It will thus be seen that all the elements necessary for rapid decomposition are in full force in a graveyard in this country.

The following are the opinions of some well-known Indian medical authorities on this subject :

Dr. James Anderson, late Presidency Surgeon, Calcutta, says:—" Native cemeteries situated in the midst of a populous neighbourhood, must be most objectionable not only from the carelessness with which the dead are covered up, and the frequent exposure of the corpse by the inroads of jackals ; but also from the greater virulence of effluvia arising from putrid or decayed animal matter when disseminated in a hot moist atmosphere, at all seasons more or less mixed with the emanations from decomposed vegetable matter." Dr. Anderson gives an instance, which had come under his own observation, of direct injury arising from the incautious inhaling of the foul vapours arising from a putrefying corpse : " The son of Mr. L'Estrange, the apothecary of the Presidency General Hospital, then a pupil at La Martiniere, wandered into this cemetery (Kasia Bagaun, south of Camac Street), and having approached a grave which had been invaded by jackals, was nauseated by the effluvia therefrom, and hurried home, complaining of sickness, and with a violent headache. He was attacked the same night with low typhoid fever, and though he recovered after a long and painful illness, his life was for some time despaired of." Another curious but well authenticated case is quoted by Dr. Johnson (*Influence of Tropical Climates*) :—

An American merchant ship was lying at anchor in

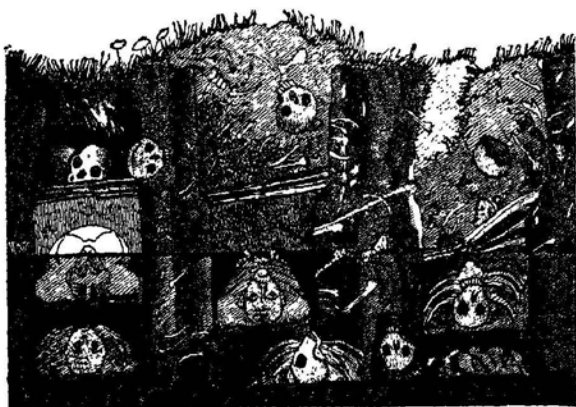
Wampoa Roads, 16 miles from Canton. One of her crew died of dysentery, and was taken on shore to be buried. No disease of any kind had occurred on board during the voyage. Four men accompanied the corpse, and two of them set to work to dig a grave. Unfortunately they hit upon a spot, where a body had been buried about two or three months previously (as was afterwards ascertained). The instant the spade went through the lid of the coffin, a most dreadful effluvia issued forth, and the two men fell down nearly lifeless. It was with difficulty that their companions could approach near enough to drag them from the spot and fill up the place with earth.

The two men affected were taken with some difficulty on board. They were attended to by the Surgeon of an English East Indiaman, but in spite of every care one died on the evening of the fourth day, the other on the fifth; both the other men suffered from similar symptoms, one of them being for three weeks unfit for duty. I need not quote at length the medical history of these cases as given by Dr. Johnson; but the disease appears to have been a very malignant typhoid fever, accompanied with suppurating buboes and other complications. The men were attended, and the *post mortem* examination conducted, by Dr. Hamilton of H. B. M. S. *Britomart*.

Dr. Norman Chevers, speaking of an old Mahomedan burial-ground in the immediate vicinity of Calcutta, says:—"It is scarcely possible that a burial place so large and so saturated with decaying animal matter can, in a tropical climate, be otherwise than offensive and dangerous to the inhabitants of its near vicinity. It is self-evident that the prevailing mode of burial in shallow graves, lightly filled in and ill-covered, must be attended

with the constant disengagement of noxious gases from its entire surface."

Dr. Goodeve says, in answer to a question put to him in connexion with a Mahomedan burial-ground:—"If by the phrase intolerable nuisance complained of by the residents in the neighbourhood of the burial-ground is meant bad smells distinctly traceable to the graves, I should consider this sufficient evidence that the products of the decomposition of the corpses were being diffused through the atmosphere, and should have no doubt that the burial-ground was a source of danger to the neighbourhood."



The above sketch will give some idea of the condition of an ordinary Mahomedan burial-ground, well known to the author. It represents a section of the ground ten feet in length by five feet in depth. A is a recent grave, P being the platform of sticks placed to keep the earth from the body, and to provide the space for the defunct Moslem to sit up in, after his burial, to answer

the interrogatories of the angels *Munkir* and *Nakeer*. B is an older grave, which has fallen in, the weight of the earth having broken the sticks, and the composition of the soil is, as shown, made up, to a large extent, of human remains of various ages; the ground being so crowded with graves that the same spot is used over and over again. W W is the level of the subsoil water in the rains. A few months ago, while inspecting this ground, the writer saw four skulls, in various stages of decay, thrown out from one grave, which was being dug to receive a new tenant then awaiting interment, while the earth presented a greasy, adipoceros appearance, and there was a most sickly offensive odour from the stuff thrown out of the grave.

We have now to consider how to remedy the evils arising from old and overcrowded burial grounds, and how to regulate interments in grounds still in use, so as to economise space and comply with sanitary requirements.

All old and unused burial grounds, and such as have from constant use become overcrowded, should be at once taken in charge by the local authority; all further interments should be strictly prohibited; and where possible, or funds will allow, the ground should be fenced in.

Bones, skulls, and other remnants of mortality should be collected from the surface and thrown into the many sunken graves that will be found throughout the ground. These graves should then be filled up, and the whole surface of the burial ground should be dug over or ploughed and levelled; all noxious weeds and undergrowth being removed or dug in; all masonry tombs, which are not entirely decayed, or which have tablets, or other

means of identification, should be carefully preserved, cleared of *peepul* or *bur* trees, and other destructive plants, and fenced in with a simple fence of bamboo or gran sticks.

In a Report on Extramural Sepulture presented to Parliament, the following statement occurs:—

“From the concurrent testimony of grave-diggers, sextons, and others employed in churchyards, it appears that decomposition goes on much more rapidly near the roots of trees than in any other parts of the burial-grounds. That the root fibres travel towards the graves and are often observed to penetrate right through the decayed wood of the coffin lids. The action of the vegetation arrests the products of decomposition, and prevents their escape into the air by absorbing them into its own substance, to be given out in another and a harmless form.”

Dr. Ford, President of the Board of Health, Philadelphia, considers that “it would be better if disused graveyards were converted into parks and planted with rapidly growing trees and herbage, to absorb the organic substances contained in the soil;” and Dr. Adams further suggests, that it would be a wise precaution to surround every cemetery with a belt of trees to act as a barrier to the escape of deleterious miasmata.

The whole area should then be planted out with plantains, guavas, sissoo, rain tree, (guango, *pithecolobium saman*), or where fodder crops are desirable, with maize, guinea grass, reana, and lucerne; but it will, probably, be found more convenient, as well as less objectionable in point of *prejudice*, to plant the ground thickly with trees, making choice of such as either fruit early, or can

be used for poles, charcoal, or firewood, within six or seven years, as after the expiry of that period the ground will again be fit for use for its original purpose.

All testimony on the subject goes to prove that a corpse laid in the earth, without the intervention of a coffin, will be resolved into the elements in five to six years, and that the ground may be re-opened without danger after the expiry of that period. Dr. Sutherland, one of the members of the London Committee on extra-mural sepulture, reported "that he found the great utility of vegetation in shortening the period of decay fully recognised abroad." There can be no doubt also that decomposition takes place much more rapidly in a hot moist climate with a wet subsoil. We have even the authority of the first grave-digger in Hamlet, that "your water is a sore decayer of your whoreson dead body;" and the same authority, in answer to Prince Hamlet's enquiry, as to "how long a man may lie i' the earth ere he rot," declared, that "he will last you some eight years or nine years, a tanner will last you nine years, his hide is so tanned with his trade, that he will keep out water a great while." My readers may smile at my taking this creation of Shakespere's imagination as an authority, but as Samuel Smiles says of the immortal bard, he was "not one, but all mankind's epitome; he gathered his wonderful stores of knowledge from a wide field of experience and observation," and there is little doubt that his grave-digger was a living character, and the opinions given, the result of actual enquiry, for of this they bear internal evidence; but to come back to more modern, and probably more reliable, authorities, Dr. French, Civil Surgeon of 24-Pergunnahs, was of

opinion that five years will suffice, though the late Dr. Goodeve has left on record that "graves should not be disturbed for at least twelve or fifteen years."

The late Dr. Parkes of Netley says:—"Bodies decay in very various times, according to soil, access of air, amount of pressure, &c. In some cases they may be destroyed in three years, but, as a rule, when ground has to be used over again, a period of from five to thirty years is allowed in different countries before reinterments. Bodies should be buried deeply (from four to six feet), in order to lessen the chance of contamination of the air, although it is supposed that when the graves are shallower decomposition is more rapid.

"The decomposition of bodies occurs by putrefaction with rapid disengagement of effluvia by a sort of insensible decomposition, the products being arrested or decomposed by the earth and by saponification. This last condition is said especially to occur if the earth is too closely pressed on the body, and gets saturated with the products of decomposition." (Public Health, by the late E. A. Parkes, M.D., revised by Aitken.)

This process of saponification results in the transmutation of the fat and muscular fibre of the body into adipocère, a soft unctuous waxy substance of light brown color, and which was first discovered, it is believed, by Fourcroy, during the removal of the Cimetière des Innocents in 1787.

Mr. Pereira, for many years undertaker, and custodian of the military burial-ground at Bhowanipore, assures me that, after the expiry of twelve months, only the larger bones remain; and from repeated enquiries and examination of the Mahomedan graveyards in the suburbs, I

am convinced that, after five years, a grave may be opened without danger ; there remaining nothing but crumbling bones, the organic matter of which, *viz.*, about 30 per cent., disappears after burial for three or four years, leaving only the inorganic constituents, *viz.* calcic phosphate, calcic fluoride, calcic carbonate, and magnesian phosphate, all compounds of calcium, behind ; and that, if the graveyard be planted as above suggested, it may be used again without danger to health or offence to decency after a lapse of five to six years. Of course, the longer time that we can let the ground lie undisturbed, the better.

The following arrangement proposed for the suburbs of Calcutta will serve to show clearly how ground may best be utilised so as to give the greatest amount of facility and economy of space with due regard to sanitary requirement :—

“The number of Mahomedan deaths in town and suburbs in 1877 was 8,600. It is necessary to provide for at least that number of burials annually.

“The number of graves to a cottah of land, allowing for each grave 6' by 2' with 4' space between each, would be twelve, or two hundred and forty to the bigah ; about 36 bigahs, or allowing for *pucca* tombs, say 40 bigahs, of land will be required annually. The lands now proposed to be taken would, therefore, last for six years, as, after three years, the intermediate four feet spaces would be used without disturbing the graves on either side. After the expiry of this period, the old burial grounds would be again fit for use, as the *cutch* graves would be obliterated, and all trace of the bodies would have disappeared.

“These grounds would last for four or five years, which

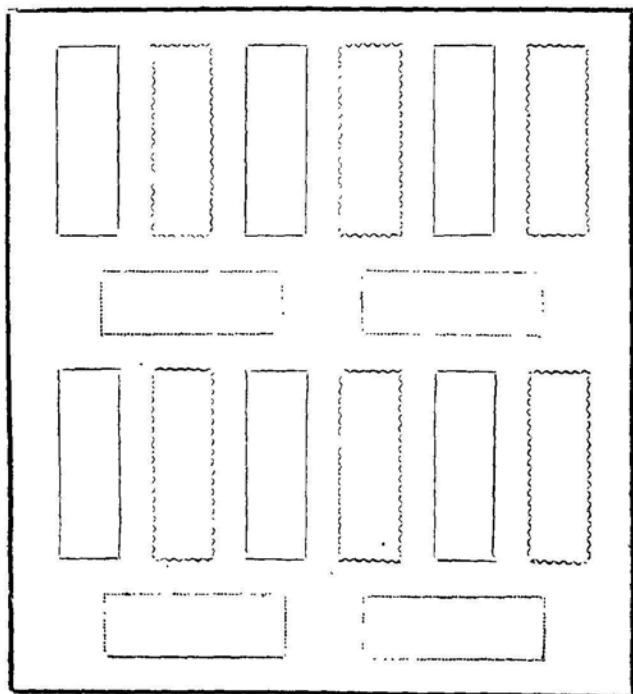
would give the first year's graves of the new ground about ten years to be untouched, and even then fresh ground would be available by using the cross spaces as shown in the following sketch :—

References.

First year's graves marked —

Fourth year's graves ————

Eleventh year's graves



“As these latter spaces would allow only half the number of graves per cottah, they would be exhausted in

18 months; but this would extend by so much the time the old graves would lie fallow, and the ground would be worked over in lines parallel to the eleventh year's graves."

By following out this system the ground could be used for an indefinite period.

The ground space prescribed by the Sanitary Commissioner is 6' \times 2' wide, one yard intervals; but this would not permit of the intermediate graves without disturbing the old ones.

CHAPTER VI.

"Prohibetur ne quis faciat in suo, quod nocere possit in alieno."

(It is forbidden for any man to do that on his own property, which may injure the property of another.)

There are many trades and manufacturing processes which add considerably to the impurity of the atmosphere, and should not, therefore, be permitted in populous neighbourhoods.

The offensive and unwholesome trades,* which the Municipal law of Bengal gives local authorities power to suppress or confine to certain limits (*vide* section 285, Act V of 1876, B. C.) are :—

1. Melting tallow.
2. Boiling offal or blood.
3. Skinning or disemboweling animals.
4. Soaphouses, oilboiling-houses, and dyeinghouses.

* By English law, a man may become responsible for a nuisance in various ways,—such as erecting and working a tallow-furnace, limekiln, tanpit, pigstye, privy, smelting-house, dye-house, Guano warehouse, noisy forge or workshop, brewhouse, glass works, burning lime or bricks so near the dwelling of his neighbours that the smoke, noise, or smell renders it unfit for habitation, or by making a cesspool, the filth of which percolates through the soil and contaminates the water of his neighbour's spring, or well, &c., &c.—*Handy Book of Law and Equity.*

5. Tanneries, slaughterhouses, brick, pottery, or limekilns.

6. Any manufactory or place of business from which offensive or unwholesome smells may arise.

And under this latter head we may place the following :—

- (a) Collecting and storing bones, horns, and hoofs.
- (b) Dry-fish stores.
- (c) Bone-crushing or phosphatic manure works.
- (d) Shell-burning.
- (e) Cinnabar-making.
- (f) Lacye and shell-lac works.
- (g) Nitric and sulphuric acid stills and chemical works.
- (h) Dry salting and hide storing.
- (i) Leather-varnish boiling.

The effluvia arising from tallow-melting, offal-boiling, soap-boiling, bone-crushing, shell-burning, and lacye-making are all very offensive, and undoubtedly constitute a nuisance within the meaning of the common law. They are caused by the fumes driven off in process of manufacture and from the decomposition of animal matter. Dr. Ballard declares that they cause headache, nausea, and diarrhœa.

Brick-burning gives forth peculiarly pungent and irritating fumes, the exact nature of which is not known, but often of a sulphurous character, due to the use of inferior coal. In England, where the brick-clay is often mixed with cinders and the siftings of dust heaps, the fumes given forth are believed to be composed principally of hydrochloric acid.

Beyond the annoyance caused, which, however, amounts

to a nuisance, there does not appear to be any evidence of injury to health from these fumes, unless breathed in a concentrated form, when they are fatal.

Shell-burning is particularly offensive, the shells often containing a large number of dead mollusca in a state of putridity. The shells are brought principally from the Sunderbunds, and are of two kinds—jhangra and jinak.

The manufacture of artificial cinnabar (bi-sulphuret, sulphuret, or sulphide of mercury or *hingool*), though not carried on to any great extent, is a most dangerous one, and should not be permitted in any populous quarter. Cinnabar is a weighty crystalline precipitate, formed by the amalgamation of sulphur and mercury, sublimed by subjection to great heat in glass retorts covered with a coating of cowdung and clay, and placed in a sandbath over a powerful furnace. The heat being maintained steadily for a period of about four days and nights, the result is a heavy crystalline substance breaking with a bright metallic fracture and of a deep red color, when pulverised. Its wholesale value is about Re. 1-4 per pound. It is largely used in the arts in the production of vermilion and other colors, and also by the natives of India as a medicinal fumigating agent. During the manufacture, the mouth of the retort is kept open and the sulphurous acid gas generated, which is highly inflammable, rushes out in a jet of flame about two feet high. The sulphurous acid gas and volatilised mercurial fumes driven off in this process have a marked deleterious effect on the health of the neighbourhood, while vegetation within reach of its effects perishes, and fish and frogs die in the tanks.

The effects on human beings are a cachectic state of the constitution, diarrhœa, cough, spongy gums, loosened teeth, foul breath, and the usual symptoms of mercurial poisoning.

Chemical works are neither numerous in this country, nor do they, as a rule, injuriously affect the health of the neighbouring inhabitants to any appreciable extent.

The process of leather-japanning, which is a considerable trade wherever shoe-making, harness-making, and carriage-building is carried on, involves a most offensive process in the boiling of the varnish, which is a compound of impure linseed oil, verdigris (acetate of copper), China blue, and English black, and which, in process of boiling in large open coppers, gives forth suffocating and poisonous fumes, which pervade the atmosphere to a considerable distance, and are a source of very serious discomfort to residents of the neighbourhood.

The nuisance arising from lac-dye works is caused by the large quantity of putrid animal matter, the remains of the lac-insect (*Coccus lacca*), contained in the refuse.

Bone-boiling is a most offensive trade, and is becoming a very common one in this country from the increased demand for phosphatic manures for tea and coffee cultivation. Any accumulation of bones in a raw state speedily becomes offensive, in warm weather especially, the animal oil oozes out and becomes decomposed, and butyric,* capric, and caprylic acids are formed; to these ill-smelling constituents are added the ordinary gases of decomposition. Storage of raw bones should never be permitted

* Butyric acid,—an oily, limpid fluid, having the smell of rancid butter and an acrid taste, with a sweetish after-taste, like that of ether.

amongst, or adjacent to, dwellings, the odours arising from them being a most disgusting nuisance. Bone-boiling, where the bones are perfectly fresh, is no more offensive than cooking on a large scale; but where the bones are tainted and decomposition is present, the effluvia are extremely objectionable.

Several cases of the kind, where sickness in the neighbourhood was distinctly traceable to the nauseating odours from this trade, have come under my notice, and prosecutions had to be instituted to suppress them.

Hoofs and horns, from which the 'cores' have not been removed, become putrid, breed maggots, and become extremely offensive.

The odour from superphosphate works is at times a serious annoyance, as it is of a very penetrating quality and diffuses itself over a wide extent, sometimes from one to two miles from the site of the works. Where dry bones alone are used, the nuisance, though generally complained of, is not of a very serious character.

Tanneries when under European supervision, or conducted on European models, are not generally a nuisance; nor do I find tanneries mentioned amongst the offensive trades recognised by English sanitarians. Still, on account of the odours diffused by them, and which are not always of a pleasant character, they generally are, and always should be, placed at the outskirts of a town. Small native tanneries are, however, an undoubted nuisance, which is heightened by the waste water, largely impregnated with decomposing animal matter, being allowed to run into open surface drains or on to waste lands and hollows. The tan-barks used in this country, viz., babool (*Accacia farnesiana*) and

goran (*Rizophora decandra*), are much less rich in tannin than the oak (*Quercus*) and sumach (*Rhus cotina*) used in Europe, and they are thus less powerful in arresting decomposition. The subject of slaughter-houses will be dealt with in another chapter.

Although many of the trades mentioned above may possibly be carried on without causing serious annoyance to any neighbourhood, whilst thinly populated, and especially where proper precautions are taken, and the works are carried on on a large scale with modern appliances and under skilled supervision, they may become—and when conducted in the careless and primitive manner in vogue amongst natives, they are sure to become—nuisances, and it is better to exclude them altogether from populous neighbourhoods, and relegate them to out-of-the-way localities, where they can offend no one. But even here sanitary supervision should not be relaxed, but the owners should be compelled to use such ordinary precautions as are practicable and necessary to prevent nuisance, if only to preserve the health of their own workmen, who may otherwise not only suffer themselves, but communicate disease to their families, or carry it into the more populous parts of the town.

There is another source of air pollution, which, though as yet perhaps of little moment in this country, promises within a few years to add seriously to the contamination of the atmosphere of Calcutta and its extensive suburbs, as well as of Howrah, Serampore, and the towns along the banks of the Hooghly, and which it would be well that local authorities should not overlook, but endeavour to check in its infancy, and whilst its regulation will be much more easily effected than after it has in-

creased to such an extent as to involve the self-interest of a large number of the mercantile and manufacturing communities. This is what is denominated in Europe as *the smoke nuisance*, which pollutes the air by poisonous gases and by unconsumed particles of carbon, which not only blacken and discolor buildings and public monuments, but choke and destroy vegetation, and exert a very detrimental influence on animal life.

Every factory or place of business consuming a large quantity of fuel and creating smoke should be compelled to consume it.

Amongst the offensive trades, which by law are placed under the control of municipal bodies, are the keeping of horses, ponies, cows, horned cattle generally, sheep and goats.

In rural districts none of these are likely to cause any nuisance; it is only when they are kept in crowded, ill-ventilated, and badly drained localities in towns, that the emanations from them become a source of danger to health and annoyance to their neighbours. Hackney carriage, or as they are called here "ticca gharry," stables are generally kept in a most filthy and insanitary condition. They are nearly always tiled or thatched sheds, with either an imperfect planked floor, or more often the unprotected soil; the wet and urine soaks through and oozes out through the bottom of the shed to the nearest drain, or on to the unpaved yard or open space adjoining. The manure is either heaped up in the yard or thrown into a pit or low ground at the back of the stable, and there is a constant and disgusting odour of ammonia resulting from the decomposition of the urine, and the rotting of the straw and dung.

The floors and drains are the chief points to be attended to ; it matters little, what the roof is made of, so long as it is water-tight and a sufficient protection from the sun ; and in a warm climate the more open and pervious to air the walls are, the better in every respect.

The floor should be made either of wood properly and firmly laid with tight caulked joints, and well saturated with Rangoon oil or coal-tar, and with a slight slope to a properly-constructed brick or artificial stone drain, jointed in either case with cement ; or the floor may be of stone, brick-on-edge cement pointed, or asphalt. The latter, when properly laid, makes an excellent flooring, and is next to wood, less tiring for the horses to stand on ; but is not lasting, and in hot weather is apt to become soft. The drain should lead to a cesspool, from which the contents may be removed by a barrel-cart. The urine and drainings should never be permitted to run into the roadside surface drains.

Where stables are situated, as is commonly the case, close to the edge of the public road, the stable-owner should be compelled to pave or macadamize the flank of the road from the edge of the drain up to the metal-ling for the full breadth of his stable frontage, otherwise the roadside gets trodden up into mire mixed with urine and manure and becomes a nuisance to the street. Every stable-owner should be compelled to have a proper box or basket to contain the horse-droppings, which they should empty into the conservancy carts when they make their morning rounds. Pigsties are a very serious source of nuisance and pollution of the atmosphere, especially where the animals are herded together in large numbers. So far as I am aware, pigs are not kept in

large numbers in any town in Bengal, except in the suburbs of Calcutta, where there has been for years a colony of Chinamen who carry on a considerable export trade in hogslard.

In some of these men's sties I have found from 12 to 1,500 full-grown swine grovelling in a mass of foul, foetid, sour mud, a compost of mire, dung, urine, and waste food. As the animals are fed on decomposed rice and sour swill, the combined odours were simply disgusting, and the air of whole neighbourhoods within a circle of a mile was vitiated.

The constant fighting and squealing of the animals adds to the discomfort of the neighbours, and the scorching off the bristles from the slaughtered hogs gives rise to disgusting odours.

Pigs kept in smaller numbers by Domes, Chamars, and other low castes are also a nuisance; their pens are invariably filthy, and they are generally allowed to roam about the neighbourhood, acting as scavengers, rooting up and destroying the drains and roadsides, invading the gardens of the residents, and frightening horses on the public roads.

Pigs should on no account be permitted in a town, especially in this country; they are a distinct nuisance, with no compensating advantage. All our local sanitary authorities and leading medical men have condemned them.

Sheep-pens are offensive to their immediate neighbours; the sheep being herded together, a very strong and penetrating odour arises from the animal matter contained in the fleeces. This is so well recognised in some places in France, that the water from the sheep-washes,

is carefully utilised for manure. If the yards and sheds are paved or concreted or asphalted, and the dung carefully collected and removed, there can be little objection to the existence of sheep-pens, except in very thickly populated localities or in the better quarters of a town.

Far worse than the horse and pony stables are the 'goalhurs,' or cow-byres, situated within towns, and their influence on the health of the people is manifested in so many ways that they call for something more than a passing notice.

Few people who have not seen these places can have any conception of their unutterable filthiness, and I am convinced that a visit to one of them would cure any one of a penchant for milk in any shape for the rest of their lives.

The gowalla's quarter is generally situated on the margin of a tank or pond, the water of which is constantly contaminated by the flow of urine and decomposing liquid dung, and from whence the cattle and the milk are alike watered.

"A cowhouse is generally a long shed, either thatched with straw, or golepattah, or tiled; the walls of bamboo matting, daubed with a plaster of cowdung and clay, with a clay floor raised a couple of feet from the ground level; the floor slopes inwards to a narrow drain usually formed of three planks, one forming the bottom and the other two the sides, held in position by bamboo pins driven into the earth about nine inches wide and ten or twelve inches deep; the flooring is covered with rough, loose boards, and neither it nor the drain being carefully fitted or caulked, the liquid dung and urine pass freely through the wide interstices and soak into the earth

beneath. Along each side of the shed is a raised ledge of earth in which earthen tubs or *nands* are sunk to hold the cow's fodder. The cows are tied up to posts set along this ledge with their hind feet close to the edge of the centre drain, so that they may dung directly into it. This arrangement is made to save the gowalla the trouble of clearing up the dung, but the space is so narrow that when a cow lies down she does so obliquely, and as they are closely packed together with their sides almost touching, the standing cow often dungs over the one resting. The beams and roofing are covered with a thick mass of cobwebs, black with the dust and smoke of years. There is seldom more than one door to this filthy den, and over that hangs a thick coarse curtain of gunny or such like material. A fire of dried cowdung is kept constantly smouldering inside the hut to keep away flies and mosquitoes, so that there is hardly any light, and the atmosphere is stifling from smoke, the carbonic acid gas exhaled by the cows, and the emanations from the constantly-decomposing dung and urine. The centre drain leads into a cesspool situated just outside the hut; these vary from six to twenty feet in diameter, with a depth of eight to ten feet, and are never emptied, though during the rains the contents overflow over the surrounding soil or into the nearest ditch or public drain. Sometimes under pressure from the conservancy officials, these cesspools are covered over by throwing litter and loose earth over them, forming an artificial quagmire, on the surface of which rank grasses grow, and so disguise them; and they are so numerous in a gowalla village or busti that a stranger must trust to the safe conduct of a guide to see him

Mortality among Milk Cattle

safely through." * The whole of the foundations and surrounding ground on which these cow-stables stand are so thoroughly saturated with urine and liquid dung, as to resemble more an old midden stead than wholesome earth. It will hardly be believed that such places have been tolerated for years, and still exist, not only in the suburbs of Calcutta, but even in the town itself, and that there are numbers of so-called intelligent and certainly educated people who defend their existence and strongly oppose their removal, on the ground that the gowallas have resided and carried on their trade in these quarters for many years, and that their removal to more remote quarters of the suburbs might lead to inconvenience the people in obtaining their milk-supply as well as increase the price of that necessary article.

The first evil arising from this penning up of cattle (for it must be remembered that the milchcow never comes out of this filthy den until her milk having dried up, she goes to the butcher) is the propagation and spread of rinderpest. The mortality amongst the cows is very great. In 1872-73 I found from careful enquiries that about three thousand head of milch cattle had died from this disease in some of its forms in the suburbs of Calcutta, and the Government Commission appointed to investigate into the Indian Cattle Plague in 1871 ascertained that, of the cattle kept in the city and suburban dairies, 87·5 per cent of the stock were attacked with rinderpest, of which 55·5 of the number kept, or 62·8 of those attacked, died. "This," said Dr. Hallen, one of the veterinary members of the Commission, "is the result of an unchecked rinderpest among cattle crowded together

in unventilated sheds and surrounded by insanitary influences of all sorts." The Commission reported that, "the state of the byres of Calcutta affords the best illustration possible of the evil effects of crowding. When disease enters these sheds or byres, it does not leave a single susceptible animal unattacked, dairy cattle are kept pent up closely in confined sheds, and the stock is periodically renewed, and if a new purchase brings disease, it spreads unfailingly among the rest." The Commissioners might have added that when disease once enters such a byre it never leaves it, but remains lurking in the soil, in the walls, and in the very atmosphere, waiting the entrance of new victims; for Dr. Hiram Farrell, M. R. C. V. S., says:—"The disease is highly infectious and contagious; the virus can be transmitted in various ways. The excrement which drops from a diseased animal is highly charged with the poison; in fact the very air in the neighbourhood of cattle-sheds with infected animals is poisoned." Now we know as a fact that when the disease has been present in these byres, even though the owner may have lost half his stock, he makes no attempt to disinfect the place; how could he indeed—for nothing short of burning down the filthy sheds and digging out the foundations, could ever disinfect such a thoroughly corrupted mass.

A significant proof under the author's own observation that the gowalla sheds are *foci* of cattle-disease is given by the fact, that of a large number of municipal cattle attacked with cattle-disease during 1878 and 1879, only those working in the gowalla quarters suffered, while others working in other parts of the town were exempt.

We now come to the important question of the milk-

supply derived from cattle kept under these conditions, and it must be admitted that, in a country like India, where milk forms an important item in the food, not only of the infant, but of the adult population, this is one involving sanitary and economic considerations of the highest importance; that the health of the cattle kept pent up in close cow-stables is largely affected by the keeping of dung in about the stables, is clearly shown by the result of investigations made by Dr. Ballard during an epidemic of cattle-disease near London. It was found that only eight out of thirty-one stables inspected, in which dung or urine was *not stored*, had had cases of disease, whilst *eight* out of *eleven* in which dung *was stored*, had the disease; and on another occasion, cattle-plague was found in 66 *per cent* of the sheds in which dung was not stored, and 91 *per cent* in those in which it was kept.

How much of the preventible sickness and mortality in our towns might not, with some reason, be attributed to the unwholesomeness of the milk-supply resulting from the filthiness of the cowhouses and their surroundings, and the carelessness and malpractices of the milkmen, is a question which merits serious consideration on the part of our officers of health and sanitary officials. Medical testimony at home and in America is almost unanimous on this subject, and it requires no medical knowledge or training to understand that the state of filth in which the cows are kept, the prevalence of disease amongst them and their attendants, the filthy and unnatural means by which it is well-known they are forced to yield their milk in increased quantities, the foul atmosphere of the sheds where the milk is

drawn and often allowed to stand, and last, but not least, the extent to which, and the sources from which, the milk is diluted and adulterated before reaching the consumer, are all conditions incompatible with a pure or wholesome supply.

It is well-known that milk is more easily tainted than any other liquid by smoke, gases, and foul odours, and a familiar illustration will present itself to many of my readers who must have occasionally observed, that milk, which has been kept standing in a cook-room where native servants have been smoking the hookah, has attracted and absorbed the tobacco smoke to such a degree as to make it undrinkable even in 'tea.' Milk exposed to the vapour of carbolic acid or kreosote will soon taste strongly of those substances, and if kept in any badly-ventilated place or exposed to sewer or drain emanations, will rapidly become tainted and unfit for use. A recent sanitary writer says: "The great danger attaching to milk as a carrier of disease, depends upon its remarkable powers of absorption, and the rapid fermentive or zymotic changes it undergoes when it becomes mixed with putrefying matter or tainted with disease germs."—*Wilson*.

Parkes says, that milk from diseased animals soon decomposes; and Wilson states, that the milk of animals suffering from foot and mouth disease (epizootic aphthæ) produces aphthous ulceration of the mouth and gums, with swelling of the tongue and great fætor of the breath. Mr. Power considers that garget, a well-known and common affection of the udder of the cow, will so change the character of the milk that the partaking of it induced diphtheria in the human subject.

Now it will be apparent from the foregoing description of the native cowhouses that every element of pollution exists in its most aggravated form, and that in fact it is impossible for untainted milk to come from such sources. But the greatest danger to the consumer undoubtedly exists in the extent and manner in which the milk is diluted and adulterated before sale. I have had it on evidence before myself in a judicial proceeding that the witness, a milkman, having a large and respectable circle of customers, and who, therefore, claimed to sell quite a superior quality of milk, invariably added at least three seers of water to every nine seers of milk, and several milkmen admitted that they not only watered their milk freely, but added to it without scruple the milk from diseased cows, so long as they continued to give down their milk at all.

Hurro Chunder Sen, a gowalla witness, examined before the Cattle Plague Commissioners, stated: "We sell milk in Calcutta, and before selling, add as much water as there is milk. Lall Chand Marik, another witness, said: "Those milksellers to whom I sell my milk, water it, and in order to thicken it, mix with it singhara-nut* flour; the milkmen add water to the milk as long as they can without changing the color." Dr. Tounnerre, Health Officer of Calcutta, says: "The milk is largely adulterated by the addition of chalk, rice fecula, and more or less impure and filthy water."

This depreciation in the nourishing constituents of food is alone a serious consideration, but the real danger lies in the source from which the water, which admittedly

forms from 25 per cent to 50 per cent of the fluid sold as milk in our towns, is drawn. If the milkman be asked where he takes his water for general use from, he will usually point to the adjacent tank; but if his suspicions be aroused as to the object of the question, he will probably name some well-known and tolerably pure reservoir, or if in the Calcutta suburbs, he will tell you he fetches it from the Calcutta water-supply hydrants; but will any one believe that the milkman, whose conscience is so lax as to permit him to impose upon his customers to such an extent; will be so scrupulous as to the source from whence the adulterating medium is obtained. Can we believe for a moment that he will be so considerate of the public welfare as to go out of his way, transgress the tradition of the elders, and actually go to expense and trouble to procure filtered water with which to carry out his nefarious practices, when the tank is within two steps of his cowhouse door? Credat Judæus Apella! The water of the tank, when the surface scum is swept aside, though laden with sewage constituents, is passably clear. It will in no way discolor the milk when judiciously added, it will not perceptibly taint it before sale, and it is close at hand. What cares he that his cowhouse drains into it that as a Sanitary Commissioner lately reported: "The banks are loaded with dung in every stage of decomposition;" that his house sink soaks into the bank; that his own and his neighbours' privies stand close to the margin; that the children openly and habitually, and adults very frequently, defæcate on the slopes; that the whole surrounding population bathe and invariably urinate in its waters whilst bathing. He cares for none of these

things; why should he indeed? His father and grandfather before him never cared. He has been brought up in these ways and amid these surroundings from infancy. He has never, so far as he knows, suffered from them; why, therefore, should others. He looks upon the visits of Health Officers and Sanitary Officials as an intrusion, their calls for amendment as an oppressive and uncalled for exercise of authority, ways and means of lessening his profits from his trade. Let it not be supposed that the picture I have drawn above has been highly colored or overdrawn; these things are all matters of evidence; they exist to this day, and so long as they continue, they will be a lasting reproach to the local authorities concerned.

Now what say medical authorities and sanitarians to the results of this state of things. Can any human being, with ordinary common sense, believe that *poison* can thus be widely distributed in such an apparently innocent vehicle as milk, and yet no evil result; that the virus of disease can be introduced into our homes, into our daily food, into the principal aliment of our infants and yet no danger arise. There is strong evidence to the contrary. Wilson says: "As regards the spread of specific disease, there is now an overwhelming amount of evidence which proves beyond dispute that milk is largely instrumental in propagating scarlatina and enteric fever. The English Medical and Sanitary Reports contain numberless cases of serious outbreaks of disease which have been thoroughly investigated by such competent authorities as Ballard, Russell, Murchison, Netten Radcliffe, and Simon, and in which the spread of the contagion was distinctly traced

to the milk-supply; and in nearly every case there was undoubted evidence of the fact that even where the milk had not actually been diluted with foul water, the water used for dairy purposes and in which the vessels were washed was contaminated by fæcal matter.

Now, if the danger be so admittedly great in England, where the vessels used are usually of well-glazed pottery or a bright, unabsorbent material, such as tin, how much must it be intensified in this country, where the milk is kept and carried in the rough, porous, absorbent clay vessels in general use.

Yet although almost every medical journal published in England, every work on sanitation, European or American, which issues from the press, contains articles of interest and reliable evidence on this subject; although the Army Sanitary Commission has called attention to it repeatedly, there seems to be a strange apathy on the part of the sanitary and medical authorities in this country in regard to an evil which must be far greater than it is in European towns. The only reference to it that I have been able to discover is a remark by Dr. Fabre Tonnerre, for many years Health Officer of Calcutta. In his Report for 1872, he says: "The state of things above described not only discloses an unparalleled state of unhealthiness, but also makes it a question for consideration whether the milk from cows congregated in these places, which is largely consumed by both rich and poor, does not contain the germs of many of the diseases which decimate the native population of the town." Again, "whether the milk derived from cows in contaminated places and from diseased cattle, which is besides largely adulterated by an addition of chalk, rice

fecula, and more or less impure and filthy water, acts injuriously on the economy of man and developes the germs of disease is a question which I cannot treat in this Report, but there is no doubt in my mind about the question but that it is so;" but though the writer thus expresses his conviction, I cannot find that the matter was dealt with in any other form. I have searched in vain the reports of the Sanitary Commissioners of Bengal for any allusion to the subject, and I can only attribute their silence to ignorance of the existence of these monstrous evils; in fact a late Sanitary Commissioner, who was taken by the writer to visit one of the worst of these gowalla busties, said, he could not have conceived its condition had he not seen it with his own eyes, and after a thorough inspection, he remarked, alluding to the recent death of two well known medical officers, from that fell disease: "Well I can *now* understand how poor Doctors ——— and ——— fell victims to cholera."

That the difficulties in the way of dealing with these monstrous evils are very great, none know better than myself, and I admit that they have hitherto baffled all our attempts at reform, but they are too great when connected with the metropolis of the country for any local authority to deal with successfully: only combined and determined effort can remedy them, and this without the aid and insistence of the Local Government is almost hopeless. The one point to be recognised is, that all such cowstables must be removed beyond the populous part of the town, and wherever located, systematic inspection and sanitary regulation must be insisted upon.

All cow-stables or byres must be paved with stone or brick-on-edge laid in cement. Wood is too absorbent, and is apt to be attacked by white-ants; asphalte is not sufficiently firm to bear the constant stamping of the cattle, which, it must be remembered, are never allowed out of the house and is also too soft, the inside of the cowhouses having always a high temperature. Proper drains and reservoirs must be insisted upon; urine and dung must be regularly removed; but as regards the latter, only such portion need be taken away as the gowalla and his family are unable to work up daily, and dry into cakes or *gointahs* for home consumption and sale, *bois de vache* as it is termed in France, being the universal fuel of the poorer classes: no tank or pond should be within fifty yards of a cowhouse, and no surface drainage should be permitted to enter a tank. There should also be a law against adulteration or dilution of milk and for the regulation of cowstables and dairies. The short enactment passed in England in 1879, and known as "The Dairies, Cowsheds, and Milkshops Order of 1879,"* would be an useful model for imitation; it contains all that is necessary and nothing that any reasonable person could object to.

* Issued 4th February, 1879.

CHAPTER VII.

"Bound in the shambles in the ghastly row,
Midst all the anguish of departing life,
With glazing eye, and sad convulsive throes,
The fated ox dies 'neath the ruthless knife."—*Anon.*

Slaughterhouses, as conducted in this country, are generally a source of very serious nuisance; where owned and managed exclusively by native butchers they are, as a rule, offensive beyond all conception, and even when under the charge of Government officials, they are occasionally sufficiently offensive as to come within the meaning of the term 'public nuisance.'

In one of my official reports I find the following note on the state of a Government slaughterhouse not a hundred miles from Calcutta. "The slaughterhouse is an open brick-built building on the banks of the nullah; it has a plain tiled floor with a central drain; the animals are thrown down on the floor and slaughtered over the drain through which the blood flows to the nullah; the floor is out of repair, and the drain is so dilapidated that deep holes have formed through the masonry to the clay foundation beneath, and the blood soaking into these, and into the open joints of the brick-work, putrefies and gives out a most offensive smell.

"There is no proper arrangement for the removal of garbage and offal, and the vicinity is haunted by pariah dogs, adjutants, vultures, and crows. There was no screen

either on the river or road sides, and the place was most offensive, not only to the olfactories, but to the sight."

It would hardly be credited that this place was permitted to remain for years with a public thoroughfare on each side and within a few hundred yards, and open to the view of one of the principal fashionable drives of the metropolis, but this was a very minor instance of what slaughterhouses in India were before sanitary reforms were insisted upon.

I need not disgust my readers by giving a detailed account of the old native shambles at Narcoldangah and Kurayah in the suburbs of Calcutta, which would be a most appalling picture, though the author can aver from his personal knowledge, he having been instrumental in their suppression, that it could hardly be exaggerated; they have been swept away, and are no longer a disgrace to the metropolis of British India.

Filthy slaughterhouses, wherever situated, must be most injurious to public health, owing to the large collections of offal constantly undergoing putrefaction, the continual flow of blood, urine, or fæcal matter: and in India the climate, the want of proper drainage and very often the want of water, together with the slovenly habits and total disregard of cleanliness on the part of the natives render strict supervision most necessary to secure clean or wholesome food, and prevent slaughterhouses from becoming nuisances.

The nuisance arising from slaughterhouses may be mitigated by the following arrangements, which should be insisted upon:—

The slaughterhouse floor should be paved with stone flags, or where stone is not procurable, with hard well-

burnt table-moulded bricks set on edge, over a brick flat on a substantial foundation of well rammed concrete; the joints, whether in a stone or brick floor, should be made perfectly close with cement, the concrete being made either with cement or hydraulic lime. In New York plank floors are universally used; they are made of resinous pine well fitted and with joints caulked like a ship's deck, and are said to be durable and cleanly; where there is a centre drain, it should be of stone or brick, and the floor should be laid nearly level with hardly any slope, as it is less slippery and cannot be cleaned down without careful washing and sweeping, which should be insisted upon. Every slaughterhouse should have a sufficient supply of good water; this is essential, and no slaughter-house should be permitted where this cannot be secured.

The more open the sides are to allow free circulation of air the better, but the sides should be closed with wire-netting to keep out carrion birds. The pillars and walls should be well lime-washed once a month, and the drains and floor should be constantly scrutinised, and the slightest opening of joint cemented at once.

Nothing in the shape of nuisance is so offensive as the smell of putrid blood. The drain should be led into a reservoir, and the blood either carted away with the offal or buried in trenches where land is available.

The Calcutta Justices' Abattoirs* (from the French

* The five abattoirs of Paris are those of Roule, Villejuif, Grenelle, Menilmontant, and Montmartre containing in all 240 slaughterhouses. They were established by a Decree of Napoleon the 1st, 1810, and were opened in 1818.

abattre, to knock down) are models of what such places in a large city should be, and will well repay a visit. About 230,000 animals are slaughtered there annually.

The manner of slaughtering, as practised by Indian Mahomedan butchers, is very revolting, the animal being thrown on the pavement of the slaughterhouse, and the head being bent round over the shoulder, the throat is cut with a long sharp knife. It is a piteous sight to see a long line of helpless beasts lying in dumb terror, waiting their turn, and it is a matter well worthy the attention of the Society for Prevention of Cruelty to Animals.

It is quite a mistaken idea that pole-axeing cattle, as is practised in Europe, and which is undoubtedly the most humane method, would be obnoxious to any religious scruples of the Mahomedans, so long as the throat was immediately cut and blood followed the knife.

No doubt it would be difficult to overcome the prejudices, and root out old custom from the mind of the Bengali Mussalman, but where there is actually no authority for the prejudice, and where there would be no real breach of any religious command, blind prejudice should never be permitted to stand in the way of sanitary reform or the calls of humanity.

It is true that in New York the same method has been, it is said almost universally, adopted, having been apparently copied from the Jews, who form a no inconsiderable part of the population; but there the cattle are taken into the slaughterhouse *one by one*. A slip noose being then passed round one of the hind legs, the beast is hauled up, till the fore legs are off the ground,

the head being then turned till the nose and horns both touch the ground, the throat is cut with one sweep of a long keen knife, and it is claimed that the animals neither struggle nor show any sign of suffering until the convulsions of anæmia set in, when the brain is depleted of blood and consciousness must have already vanished. (Buck II, 404.) This may be so, I suppose no one can say positively, any more than they can tell whether or no the criminal's head decapitated by the guillotine retains consciousness, as some think, after it is severed from the body.

CHAPTER VIII.

" Ignorantia rerum bonarum et malarum maxime hominum vite vexatur "—*Cicero*.

(Through ignorance of what is good and what is bad, man's life is greatly disquieted.)

The rapidity with which vegetation of all kinds springs up on any waste piece of ground or drain side and the luxuriant growth to which it speedily attains in the moist steamy atmosphere of lower Bengal is really marvellous, nor is its rapid growth more a marvel than its vitality.

Opinions differ somewhat as to the effects of growing jungle in regard to health; but there is a commonly received, but erroneous, opinion, that it is productive of malaria, and it is constantly said of such and such a locality, "Oh! how can it be otherwise than feverish and unhealthy, when it is full of rank jungle," or "all that rank vegetation must breed malaria."

Now these beliefs are *right* and they are *not right*. Right in so far as they connect the existence of rank vegetation with the presence of malaria, not right in so far as they *attribute the malaria to the presence of living vegetation*. The rank vegetation is the *effect* and not the cause: it is in truth a sign of malaria, an evidence of the presence of miasmatic conditions.

Growing vegetation in fact lives and thrives on the very exhalations which are so noxious to animal life. Plants absorb their nutriment through both their roots and their leaves, the latter of which may be considered as their lungs. As animals *exhale* carbonic acid, ammonia, and watery vapour, so plants *inhale* these very elements, and by this means purify the atmosphere, whilst under the magic influence of the sun's rays they *exhale* oxygen and nitrogen, the principal components of pure atmospheric air; the action of solar light being to decompose the carbonic acid so inhaled, and to separate and free the oxygen, leaving its other constituent carbon, which is insoluble, behind in the substance of the leaf.

This decomposition of carbonic acid takes place in the cells containing chlorophyll, a resinoid body consisting of phylloxanthin (a yellow) and phyllocyanine (a blue) to which the green coloring of plants is due.

As Prof. Max Von Pettenkofer tells us,—“If the drainage of human habitations remains in soil destitute of growing vegetation, further decomposition sets in, and other processes are induced, not always of a salubrious nature, but often deleterious.” It is only the action of the living and growing vegetable which recomposes the products of decomposition and carries out to its consummation the process of disinfection, and Professor Daubeney, (Oxford Professor of Botany,) says of vegetable life that “it acts as the appointed instrument for counteracting the injurious effects of the animal creation upon the air we breathe, not merely by restoring to it the oxygen which the latter had consumed, but also by removing, through the agency of the ozone it generates,

those noxious effluvia which are engendered by the various processes of putrefaction and decay."

Growing vegetation is, therefore, to this extent a *benefactor* and *not an enemy*; and the attention of the sanitary authority should be directed not so much in the way of *cutting down* and *destroying* vegetation as in amending the *conditions* under which such vegetation abounds, and which encourage its rank luxuriance, it being remembered that vegetation flourishes not in proportion to the organic matter in the soil, but to the activity of the fermentative changes taking place in it; and that the three necessary factors for inducing these changes are heat, air, and moisture.

The following extract from one of the most complete and valuable recent works on hygiene and public health, edited by Dr. Buck of New York, beautifully illustrates this theory:

"The living vegetable has nothing to do with the production or evolution of malaria, but would rather seem to be concerned in its destruction.

"By viewing malaria as an element in the production of plant-life, exhaled from the soil and absorbed by the myriad pores (stomata) which leaves present, mostly on their under-surface, we have an explanation of the luxuriant vegetation that usually indicates its habitat. During the day under the stimulus of light and heat, vegetable nutrition is active; carbon is fixed, oxygen is thrown off, and malaria absorbed to act its part in the organism. Hence the comparative freedom from malarial poisoning conferred by sun-light. During the night, on the contrary, the plant sleeps: its nutritive functions are at a stand-still, and the unabsorbed malaria envelopes

the foliage in a rich vapour until the morning sun rouses up the organism to profit by it."

There are, however, three ways in which such vegetation acts injuriously, and consequently three reasonable arguments in favor of its clearance.

First, that it gives cover to venomous snakes, reptiles, and vermin, and encourages the propagation of mosquitoes and such *small deer*.

Secondly, that it keeps the rays of the sun from the surface of the soil, thus preventing free evaporation and drying of the surface, and maintaining a humid and malarious condition of the atmosphere; and

Thirdly, that when it has passed its maturity, it dies down, decays, and decomposes.

In addition to these three objections there is this one, that in towns it gives cover for the commission of nuisances, and therefore is, if not a nuisance in itself, a cause of nuisance.

While admitting, however, that there are on the above grounds good reasons for the clearing of jungle, such clearances should not be made indiscriminately or otherwise than under proper supervision. To cut down (as is too often done) the vegetation on waste lands and there to let it lie and *rot*, is but to produce the very evil we are trying to remedy.

It is a fact generally known to all residents of our Hill stations, that the annual cutting down or *breaking down*, as is too often done, of the rank jungle growth on the hill sides during or after the rains, is followed by more or less prevalent diarrhœa.

To cut down the ordinary undergrowth of *bun kochu* (wild caladium or arum) and *bherinda* (a species

of euphorbia) and which abound on all waste lands in Lower Bengal, at the beginning or the middle of the rains, is *worse* than useless, the jungle springs up again and the cut plants rot on the ground. The proper time for jungle-cutting is either from the beginning of the hot weather or after the complete cessation of the rains. Then the vegetation should be thoroughly cut down, and after being allowed to dry for a few days should be burnt on the ground, which should be dug over so as to turn up and destroy the roots. Cut, or rooted up plants, and *pannas* or water-plants, should never be allowed to rot on the ground, it being always kept in mind that it is the decay of vegetation, and not its growth, that produces malaria.

But this process will be ineffectual in altering the malarious characteristics of the locality, unless the land be properly drained and kept clean and free from excretal deposits and other filth. All unused waste lands in towns should be planted with trees, care being taken to select such as discourage undergrowth and yield a pleasant shade without entirely excluding the sun's rays. Aromatic and flowering shrubs and trees also aid in the production of ozone.

In the chapter on arboriculture will be found some hints as to the kind of trees and shrubs most suited for urban planting, both as regards ornament and purification of the atmosphere.
