

Friday, June 3, 1887.

GENERAL SIR BEAUCHAMP WALKER, K.C.B., Vice-President, in
the Chair.

MAIGNEN'S PATENT INDIAN "MUSSUCK" FILTRE RAPIDE.

By Mr. P. A. MAIGNEN.

In the Crimean War, the Russian Army lost between 60,000 and 70,000 men in fight, and more than one million from disease, mostly due to bad water.

In the Turkish War of 1878, Russia again lost between 13,000 and 14,000 men in fight, and 70,000 from disease.

In the various campaigns in which France took part, five medical Officers died violent deaths (two being burnt alive), and sixty perished miserably of cholera and typhus.

When Sir Frederick Roberts arrived in Burmah to assume the command in chief of the Army, he found 45 per cent. of the troops on the sick list, the greater number owing to the use of bad water.

Dr. Parkes, in his book on hygiene, quotes a very large number of cases of epidemics amongst the troops in India, these epidemics disappearing immediately the source of the water supply was changed.

In Spain last year, during the cholera epidemic, the towns in which all the hygienic arrangements were deficient, but where the water supply was good, did not suffer, whilst where the water was bad, and notwithstanding the best sanitary precautions had been taken, the cholera epidemic was most intense.

Dr. Koch observed at Marseilles, that the cholera was much worse after rain than it was before. This is a fact well known to all who have resided in tropical climates. The reason is not far to seek. The Royal Commission on River Pollution has pointed out that half-a-pint of water condenses out of 3,373 cubic feet of air; that the rain in its fall brings down with it all the dust and germs of disease contained in that air, so that in drinking one single tumbler of water, we take in one moment into our system as many germs of disease as would enter the lungs by inhalation in a whole week. Thus after rainfall, the water has not only brought with it the impurities of the air, but also those that it has met with on the surface of the ground and in watercourses.

Sir John Lister has been knighted for introducing the system of dressing wounds, so as to exclude the dust of the air from entering the blood of the patient through those wounds; yet we swallow, without a moment's hesitation or thought, whole bucketfuls of water, which goes immediately into the circulation, carrying with it thousands, nay millions, of germs of every sort.

Someone on hearing this may say that it is a wonder that any of us are alive! and so it is. Nature has provided us with a certain strength which enables us to resist *some* of the attacks of the microscopical and ultra-microscopical world. But often that strength is not sufficient to enable us to overcome the attack; in any case, many of us drag on a miserable sickly life, caused through our own fault; we have allowed the enemy to enter the system, weaken us, and play with us, as a cat plays with a mouse.

The Burdon-Sandersons, the Tyndalls, the Pasteurs, the Kochs, the Kleins, and others, have followed these germs in the air, in the water, and in the animal system. Quinine and like remedies are administered to poison these germs. Is it not surprising that so little has hitherto been done in attempting to deal with these impurities in the water, before entering the system?

I had the honour of reading a paper at the 6th International Pharmaceutical Congress at Brussels two years ago. Over 700 chemists were there, representing twenty-two different States and I do not know how many learned societies. Two whole days were spent in discussing the question of finding out the nature and quantity of the different impurities in water. Resolutions were passed declaring that water which contained more than a given quantity of organic matter, or of inorganic matter, should be condemned as unfit for consumption.

After reading my paper on the filtration of water before this Congress, and noticing the interest taken by each member in the experiments I made, a thought took strong hold of my mind—it was this. Here are 700 chemists, all men of note, knowing well that impure water is the cause of numberless diseases, yet not one of whom made a single proposition as to the means of removing those impurities which they condemned. What is the use of telling the authorities of a town, or a firm, or private individuals, that their water must not be used, if they have no other source, and if they have no means of purifying it? I have even heard men—not entirely unknown—say—"if you filter bad water, and render it drinkable, it will prevent the authorities searching for better sources!" The absurdity of this argument is apparent; any system of purification must cost something, and it is possible sometimes to find good sources, but where these good sources are not available, it seems to me most urgent that all our efforts, as men of common sense, should tend to one object, namely, the finding out the best means of eliminating from the only available water, all its impurities.

For the last year or two we have been told to boil the water we have to drink, and many have done so religiously; but take the case of the traveller, or the soldier in a campaign—how is he to boil the

water, and wait till it cools? Again, if I mistake not, Dr. Frankland and Professor Tyndall positively state that many of the germs of disease are not destroyed by boiling; and it may not be known to all here present that water decomposes more quickly the longer it has been boiled—that is, that if the water has been boiled for half-an-hour, it becomes putrid in two days, if boiled for two hours it becomes putrid in one day.

General Viscount Wolseley, when organizing the Egyptian Campaign, had a strong appreciation of the necessity of purifying the drinking water for the troops, and it was upon his suggestion that the War Office sent out a sufficiently large number of suitable filters for all the men under his command, and we may say, after Dr. Quaine, of Netley, that Lord Wolseley did, by this thoughtful precaution, save more lives from disease than any other General has ever done by all other precautions.

Until lately, filters were supposed to remove matters in suspension only, and even then imperfectly, and only on the condition that large quantities of filtering medium were used. The transporting and keeping these filters in order was an insuperable difficulty. Thanks, however, to the invention of my friend Mr. John Bell,—by which he has been able to manufacture pure asbestos cloth,—I have been able to adopt this imperishable tissue to the various forms of filters which you see before you, and to obtain the results which I am about to show.

One great advantage of this asbestos tissue, besides its lasting properties, is that it has led me to use an extremely fine filtering medium in the shape of powdered charcoal, which has the effect of removing from water not only the suspended matters, but also of oxidising, and otherwise arresting matters in solution, such as urine and lead.

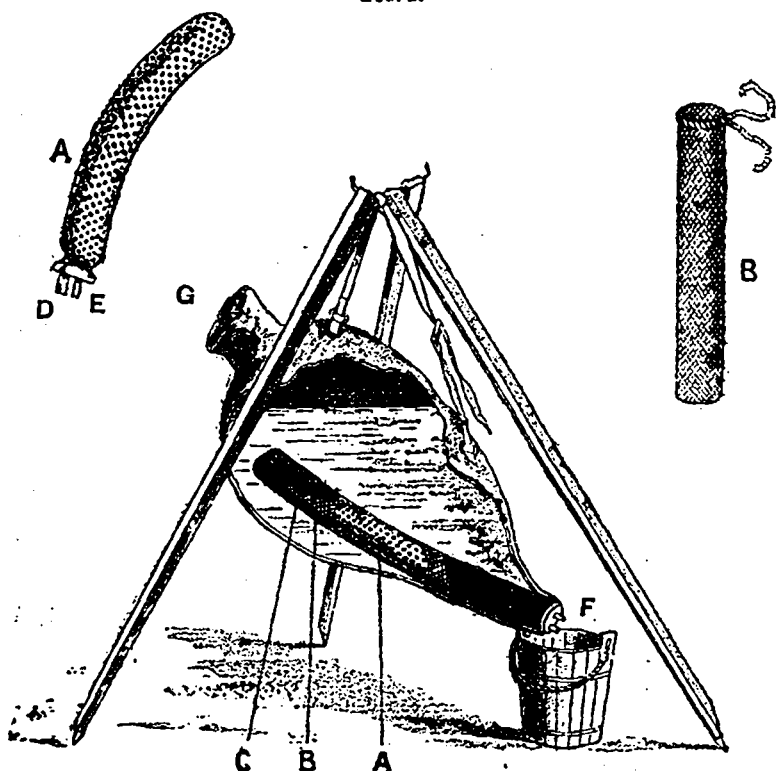
For India we take our charcoal from the mineral kingdom, so as to respect the caste prejudices of the natives, but I may say that the wood charcoal manufactured by the natives themselves would give good results.

I will now proceed to show you the various forms of filters designed to meet the requirements of the troops serving in India, Egypt, and other tropical countries.

I am indebted to Lieutenant-General Gloag, late R.A., for a most valuable suggestion, the result of which is before you, viz., the application of my process of filtration to the native "Mussuck." I am sorry that I have not been able to procure some of the native manufactured skins, which are far better adapted for the purpose than any skins I could obtain in England, but this will suffice to show the ease with which these skins can be converted into filters. It may interest some of my hearers to know that the name of Bheesty was given to the man who carries the "Mussuck," from a Persian word, "Bihisht," signifying "Paradise," thus showing the value natives of tropical lands place upon these water carriers.

It is well known that the "Mussuck," as at present used, is liable to become very foul because there is a certain difficulty in cleaning it, and then often the water, which came out of it, was more dirty than when it went in.

FIG. 1.



The improvements in the "Mussuck" filter may be summed up under three heads:—

1st. Water that goes in impure comes out pure.

2nd. The "Mussuck" is easier to clean through having an opening at both ends.

3rd. It can be used with ease, not only on the bheesty's back but also on the tripod, as shown here, or hung on the branch of a tree, or in any other available way, and water can be poured in at one end and drawn off at the other without fatiguing the man.

We have here some English-made chatties, in which we have placed filtering frames similar to those on the table. In India these vessels are used in all barracks, married quarters, hospitals, and kitchens for soldiers, and cost but a few pence, and we propose to send out simply the filtering frame, covered with asbestos cloth, to be fitted by the natives themselves in their own chatties, they using also their own wood charcoal—in another chatty we have placed one of

these frames so as to make a syphon—this of course requires no fitting, but simply a starting of the syphon.

Fig. 1 represents the "Mussuck" converted into a "Filtre Rapide." To effect this, a perforated metal filtering frame, A, with outlet, D, and air vent, E, covered with an asbestos cloth, B (tied on the frame with asbestos cord), is inserted in the mouth of the "Mussuck" at F. The mouth, after the insertion of the frame, is firmly closed over it by means of leather thongs, the usual method adopted by the natives themselves when using the "Mussuck" without the filter. An opening at G, which is the only alteration made in the native "Mussuck," allows of the rapid filling of the "Mussuck," either when carried by the bheesty or when suspended on a tripod, as in the diagram, or on the branches of a tree, or on the shaft of a carriage.

To Prepare it for Use.—Mix half a pound of powdered charcoal with the first supply of water poured into the "Mussuck" at G. Some of the charcoal will adhere to the asbestos cloth, as shown in C, and effectually close its pores so that no impurities whatever can pass through—the remainder, by being agitated in the water, gives it an additional degree of purification.

To Use.—The air vent plug is removed when the filter is in action so that the air circulates freely in the filter frame and allows the filtered water to come in and go out of the frame with ease.

The "Mussuck" filter should be cleansed once a month, and more frequently if the water is very bad.

To clean it, untie the leather thongs, pull the filtering frame out, dash water on the surface of the asbestos cloth, rub off the old charcoal with the hand, or with a soft brush, and after having rinsed out the "Mussuck" itself, replace the frame as before.

Fig. 2 represents a section of Maignen's Patent "Bucket Filtre Rapide" in actual working order. The two pails shown in use in

FIG. 2.

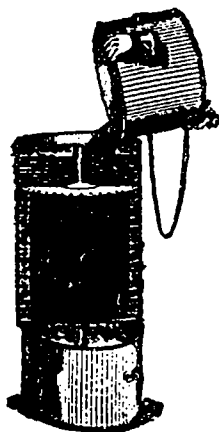


FIG. 3.

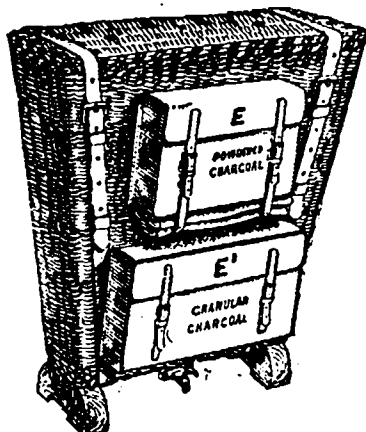


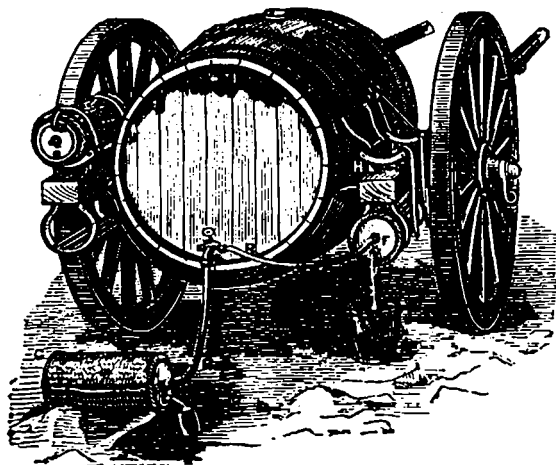
Fig. 2 fit over each end of the filter and are fastened together by a leather strap, which can be used as a handle. For further protection and convenience of carriage, these filters are provided with a strong wicker basket, which measures 16 inches by 12 inches by 12 inches. The weight of the filter without the basket is only 16 lbs.

Fig. 3 represents Maignen's patent "Field Hospital Filtre Rapide." This pattern has now been in use in Egypt for more than three years, the first order having been given on the 26th September, 1882, and has given such universal satisfaction as to induce the authorities to declare other filters previously used in field hospitals obsolete and to be dealt with accordingly.

Granular carbo-calcis is used in this filter in addition to the powdered, and the cleansing operation is performed only once a month. The pouch (E) in Fig. 3 contains eight charges of powdered carbo-calcis, and (E') part of a charge of granular carbo-calcis. Two canvas buckets are folded and held by leather straps between the two pouches.

The measurement of Maignen's patent "Field Hospital Filtre Rapide" is as follows:—The total height of the basket is 2 feet $3\frac{1}{2}$ inches; the width at the top is 1 foot $11\frac{1}{2}$ inches; and the width at the bottom is 1 foot $3\frac{1}{2}$ inches; the depth, including the pouches, is 9 inches.

FIG. 4.



This is the last pattern of filters sealed by Her Majesty's Government for the use of the Army, September, 1886. Each water-cart sent out is intended in future to be provided with a pair of these filters; they purify from ten to twenty gallons of water per hour each (Fig. 4).

This filter has been specially designed for the use of Officers in the British Army. It is carried in a tin case, which measures $3\frac{3}{8}$ inches

by 2 inches by $3\frac{1}{2}$ inches, and which can be used as a drinking cup (Fig. 5).

FIG. 5.



The net weight of the "Watch Filtre Rapide" is 8 oz. The weight of one tin of carbo-calcis (for twenty charges) is 4 oz. The gross weight (including cup, and packed for post) is 1 lb. 5 oz.

Mr. P. A. MAIGNEN: The natives of India from time immemorial have used the chatties above referred to, and by utilizing them we save an enormous amount of money which otherwise would be required in order to send out filters to that country, of which the natives themselves might not approve, as they are very conservative and wedded to old habits and customs. The filtering frames which we supply are to go into the chatties and the mussucks.

Captain BURGESS: What does this attachment for the Indian mussuck cost?

Mr. MAIGNEN: Not more than 17s. for filtering from 5 to 10 gallons an hour.

Captain BURGESS: How long will it last?

Mr. MAIGNEN: The cloth will last ten or twenty years; nothing wears out but the charcoal, which they make themselves. Dr. Bartlett having compared this charcoal with such germs of disease as they have access to, has found that the particles of the charcoal are smaller than these germs or microbes, so that if the charcoal does not pass the microbes will not pass. The asbestos once saturated with the powdered charcoal is an absolute clarifier; all that is required to cleanse the asbestos cloth is to dash water on to it. The best claim that our invention has to your attention is that it has been used by the British Army of the Nile Expedition. Eight hundred of the "bucket" filters shown here were sent up with the boats, and the Camel Corps had one hundred each. These bucket filters have also been sent out by the India Office to India. They consist of a filter and two pails fitting over it, which are used one for holding the unfiltered water, and the other to receive the filtered water. Six weeks of supply of charcoal was carried in a box inside the filters. This charcoal can be used for treating wounds, or for any of the other purposes for which vegetable charcoal can be utilized. We have also here the Regulation "Field Hospital" filter to carry on mules' pack-saddles, and a "water-cart" filter, which is to be supplied to the two army corps which are being formed. To see the use of this water-cart filter I accompanied the volunteers to Eastbourne at Easter, and had the pleasure to see that it was highly appreciated both by Officers and men. It was running at the rate of 10 gallons an hour, and the very idea of having filtered water made the soldiers go a long way to get it. We know how difficult it is to make Tommy Atkins go out of his way, but let him once believe that there is a danger in drinking whatever water he meets with, and he will go a long way to get it pure. I have here a model of a filter on wheels for purifying large quantities. The actual size is about 4 feet 6 inches long, and it has 200 square feet of filtering surface, and is capable of filtering 500 gallons an hour. Of course I cannot show you the removal of microbes; it will be sufficient to say that if an impurity in solution can be removed, that which has a body, however small, is certain to be removed. I have been asked to give a reason why this particular system of filtration removes matters in solution whilst all the books say that filters only remove matters in suspension. It is like many other things we cannot exactly explain, we can only show the results; but the nearest approach to

an explanation which has found credence is this. The extreme porosity of the fine charcoal and its extremely minute size seems to be apt to condense oxygen; that is to say the little pore of the charcoal seems to say to the oxygen in the water, "You oxygen come and I will condense you," and as it were with that on the tip of its tongue this condensed oxygen seems to say to the organic matter (that is capable of oxidation), "You organic matter I burn;" to the metal in solution, "You metal I like; we combine, form an oxide; we become insoluble; we then have a body we cannot pass."

After some experiments showing the removal of lead and urea from water, Mr. Maignen said at the present moment the whole question of providing pure water for the soldiers is under the consideration of the War Office; the principle aimed at of course is to filter the water wholesale, and to distribute filtered water to the Army as you distribute bread or powder. But there are certain places and circumstances in which large bodies of water cannot be carried, and in that case recourse must be had to the water-bottle. The soldier objects and the authorities also to having an additional article to carry, and we are told that the soldier, if he has a pocket filter, finds it cumbersome, and throws it away. I have here an English and a Russian water-bottle, and we can sometimes learn something from our neighbours. The English water-bottle has a pewter screw, which is rather inconvenient; it is heavy, and not the cheapest thing to use. The Russian plug is of wood, and presents no objections. It has occurred to me to put one of my filter frames inside the bottle, so that you may drink the filtered water through the ordinary aperture. That will cost less than a shilling. The filter frame can be removed from the water-bottle, and used separately as a filter when drinking from a ditch. I have also another model, which has received the approbation of the War Office, and which has been selected by His Royal Highness the Duke of Connaught for his own use in India. Being made of enamelled iron, it is not liable to damage, and is easily carried.

The CHAIRMAN: Mr. Maignen will be happy to remain and continue the experiments, and give any further explanation to anybody present who takes an interest in the question, and I would venture to ask your leave to give him our warmest thanks for having shown us these interesting experiments.