SUPPLEMENTARY SECTION.

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A supplementary meeting was held on Saturday, October the 25th, in the Small Public Hall, George Street.

Dr. B. W. Richardson, F.R.S., President of the Congress, in the chair.

Dr. Balbirnie gave an account of his plans for constructing and ventilating barracks, hospitals, board schools, &c.

[For epitome of Dr. Balbirnie's paper, and discussion, see Engineering Section, pp. 166, 7].

The Chairman next called upon Mr. J. E. Ellison for his paper on "Ventilation of Buildings."

[For abstract of paper, and discussion, see Engineering Section, pp. 163—6].

Mr. Waller followed by explaining the method he has adopted in ventilating buildings at Herne Bay. This consists in narrowing the chimney flue about six feet from the floor line, to prevent back draught; making an outlet in the chimney breast for the foul air of the room; providing a five-inch vent or bead to the windows, so as to allow of the upper sash being drawn down without exposing any opening at the top, whilst air enters between the sashes.

The President then asked Mr. Soper to read his paper on the

Disinfection of Excreta.

When I had the honour of addressing you last year at Stafford I fear my explanations were but crude and superficial, and a year's experience leads me with bolder hands to bring my invention to your notice. I will, I promise, not weary you with more than a slight sketch. Here, then, is an apparatus made of incorrodible material, the object of which is that from certain ingredients, viz., manganese, salt, sulphuric acid, and water in definite proportions, a stream of chlorine gas is continuously evolved for three to seven days without any further attention whatsoever.

I am of opinion that of all known disinfectants chlorine gas is absolutely without a rival, and not forgetting the important part played by it as a decomposing agent by its great affinity for hydrogen, and on the score of cheapness, I know of no rival. In my apparatus it can also be evolved instantaneously, as in the form of euchlorine, when hydrochloric acid is added to chlorate of potash.

Both gases decompose sulphuretted hydrogen and sulphide of ammonium, of which most fœtid effluvia mainly consist—the effluvium of sewage especially. I employ disinfectors of every size, according to the purposes for which they are required; those of from half-a-pint to a pint are the most useful sizes. If an ambulance is to be disinfected, I would use a small size, and generate euchlorine; but for a gully hole or ventilating shaft from a sewer, I would use a gallon size. If the apparatus is suspended over a collection of manure it is curious to watch the dense gas meeting the light ammonia, and forming a visible cloud of chloride of ammonium, and with entire destruction of effluvia. I have for a lengthened time employed my apparatus in sick rooms and infectious hospitals with immense relief to the inmates, and destruction of all bad odours, without in any case a complaint of undue potency, for bear in mind my principal scheme is that chlorine shall be produced in the slowest possible form, without intruding its presence. Most of you are aware of the horrible emanations in cases of phagedæna, gangrene, &c., and with all our care the case becomes revolting in every sense to all who come in contact. I have recently had constructed a cradle covered with india-rubber; at one end is an elastic diaphragm through which a gangrenous leg may be placed. At the opposite end is a valvular opening, through which is suspended a small disinfector. Let me read you the result, and you will draw your own conclusions as to its benefit in the general ward of a hospital. A case under the care of Dr. Hammerton, in Lambeth Infirmary, of a woman, aged seventy-two, suffering with gangrene of all the toes, said to be result of frost-bite. Charcoal poultices, with carbolic acid, and chloride of lime around the bed, were ordered. A distinct line of demarcation was formed, and the gangrenous parts removed; but the disease returned, and was as offensive as ever. A generator was then used in the way I have described, and no dressing whatever was applied to the leg. Result most satisfactory; offensiveness entirely removed, discharges healthy, sloughs separated, leaving a healing surface, and in three weeks the foot was well. He says he has adopted the same arrangement in sloughing phagedæna, and with equally gratifying results. I do not mean to advise absolutely that the gas shall be wholly confined, but a certain portion will naturally escape from the end of the bed. The atmosphere of a *post mortem* room or mortuary is often peculiarly sickening: here are cases for its use. Again in typhus, if a small disinfector is placed high up above the patient's head. I believe the danger of infection to others is minimized. In the *British Medical Journal* I notice these words—"The explanation of the mortality amongst medical men and nurses is to be found in the fact that the poison of the disease is contained in the cutaneous and pulmonary exhalations of the sick, that it is conveyed through the air by fomites, that it is then inhaled, or perhaps swallowed with the saliva, and so finds admission into the blood of the healthy.

Every physician who has had any experience of typhus must be familiar with the strong ammoniacal odour of the breath, and still

more with that which escapes on turning down the bed-clothes. It has been found that those patients are most apt to communicate the disease in whom the odour is strongest. Now, this being an accepted fact, how can we doubt the efficacy of chlorine. If disinfectants are to be of service they must be continuously in the air, and disease then meets with its natural antidote, a diluted atmosphere of chlorine. I think Dr. Raikes' statement substantiates this, "that the floating organic vapours or molecules of whatever kind in the air are destroyed by the air purifiers, as shown by their influence on odours." Daily I am told by those who have never used any apparatus that an atmosphere in which chlorine reigns is absolutely prejudicial and dangerous. This I positively assert is not the case when employed as I suggest. I received a letter from the medical officer of a mail steamer, in which he says they had sickness on board, and from bad weather had to close ports and hatches, and during this time a disinfector was working with the happiest results to the inmates of the cabin. I know I am treading on dangerous ground if I read you a review of Dr. Notter's work, in the *Lancet* of Oct. 11th, for the number of disinfectants are legion, and they each have their special claims, and are mostly recognized preparations. He experimented most fully with Carbolic acid, solid and liquid, Chloride of Lime, Condy, Terebene, Sanitas, McDougal, Phenyl, Burnett, Eureka, Sporokton. A small quantity of Beef infusion was used in all the cases, which, after keeping, was loaded with bacteria, and a certain definite proportion of each disinfectant was used.

Carbolic.—Bacteria still living, but sluggish.

Condy.—Vibrio, spirillum and other bacteria in active motion.

Terebene.—Bacteria still very active.

McDougal.—Bacteria equally distributed, but activity diminished.

Burnett.—Activity of Bacteria very much diminished.

Chloride of Lime.—Bacteria nearly all precipitated in filmy clouds of disinfectant, and no movement visible.

Further modified experiments were made, but chlorine surpassed them all. I have little more to add, but to say that in the drain disinfector it is placed near the outlet of the hospital, and that it actually slips into the sewage; a stream of chlorine is continuously evolved, and the whole of the upper level of the drain pipe is filled with the gas, and as each portion of water passes the nozzle so does the water carry away with it its disinfective property, and if a defective trap exists, which too often is the case, no regurgitation of sewer gas can occur in its vitiated form. This latter apparatus being of a large form does not require changing more than once a week. This I have arranged by making it conical, so that as the acid becomes weaker so has it a smaller surface of powder to act upon, and in that way a balance is maintained.

For the disinfection of rooms I think my apparatus may be shown to have a great advantage over burning sulphur, the ordinary mode of destroying contagion, the risk of fire being no small consideration. Those who would go further in the matter I would refer to the remarks of Dr. Richardson in his "Diseases of Modern

Life," who goes fully into the danger of impure air and all its attributes.

I am informed that the principal ingredient, binoxide of manganese, may be purchased at 16s. a cwt., and the commercial sulphuric acid at about 1¼d. a pound. The salt can hardly be computed. I have made experiments on a very large scale in connection with the metropolitan drainage, with the happiest results.

William Soper, M.R.C.S.L., L.S.A.

The author showed a number of pieces of apparatus, both complete and in section, in explanation of his plan of disinfecting the excreta from hospitals, &c., and also performed a few illustrative experiments.

The President stated that Mr. Soper's apparatus had been employed for some time in his own laboratory for deodorising purposes, and complimented him on his efficiency. He also called attention to his own evidence before the Lords' Commission on Noxious Vapours.

Dr. F. de Chaumont pointed out that the question of Disinfection was one on which much misapprehension existed. Nearly all disinfectants so-called were little more than deodorants. He referred to his own experiments, which proved that even the deodorising power was not always so great as believed, and to Dr. Notter's experiments which showed that to effectually destroy the lower organisms much more powerful doses of reagents were necessary than could in practice be applied. The only true disinfectant was heat, which was of course applicable only to certain cases. The power of chlorine was admittedly great in decomposing animal substances, and destroying dangerous products, and when it could be employed in sufficient quantity it would likely be efficacious. Thus in the case of a typhoid patient the immediate addition of a strong dose of chloride of lime stools would probably render them innocuous, even if passed into the drains. This plan was adopted at Netley, where typhoid stools were immediately disinfected in this way and poured into the sea. The result was, that although numerous typhoid cases had been admitted (from board ship, for instance), no case had yet originated in the building itself. Mr. Soper's apparatus was a very ingenious one in arrangement, but the doubt that suggested itself was, whether it was really useful, having regard to the quantity of chlorine that could be liberated in comparison with the bulk of sewage to be treated. With properly-constructed and properly-ventilated sewers disinfection ought not to be required.

Dr. Ball read a paper "On an Improved Mode of Influx and Efflux Ventilation."

The paper was illustrated with a number of diagrams and experiments, and with models of the apparatus described.

The President, in the absence of Mr. F. H. Porter, read the last paper on the list.

The Softening and Purification of Water by the process of the late Professor Clark; with a notice of a system by which it is rendered more generally available.

Although nearly forty years have elapsed since Dr. Clark brought to the notice of the world, by letters patent, his valuable process for "rendering certain waters less impure and less hard for the supply of manufactories, villages, towns and cities,"—and although a few very fine examples of its application to the water supply of towns have been in existence for some years—this process is but very little known and very imperfectly understood.

To something the author of this paper has sought to do—and not without some success—in rendering the process of Dr. Clark more generally available, he attributes the invitation he has been honoured with to read a paper upon this occasion.

In the *Journal of the Society of Arts* of 1852 may be read a very lucid description of his process by Dr. Clark himself; and, embalmed in Blue-Books, the reports of three several Royal Commissions upon the quality of the water of the River Thames, upon the water supply of the metropolis, and upon the domestic water supply of Great Britain, teem with evidence of the value of this simple and beautiful process.

Professor Frankland, a member of the Royal Commission of 1868, gives in his work, entitled "Experimental Researches in Pure, Applied, and Physical Chemistry," a *resumé* of the valuable report of that Commission in relation to Clark's process of softening water by the use of lime. This report contains some account of the waterworks of the Chiltern Hills Spring Water Company near Tring, of the Caterham Spring Water Company, of the Canterbury Water Company, and those of the Colne Valley Water Company near Bushey Station on the London and North Western Railway.

The last-named were designed by Mr. J. F. Bateman, F.R.S., now President of the Institution of Civil Engineers; and the others by Mr. S. C. Homersham, C.E., who has done more than any one else to give practical effect to Mr. Clark's discovery.

One of the works just named—viz., those of Caterham, is within a walk of Croydon; and another example by Messrs. Quick and Son, Civil Engineers, is at Kenley, still nearer to this place. Shall I be though impertinent if I inquire, why Croydon has not followed the good example at her doors?

It may be that Croydon, generally, is hardly aware of the existence of these works, and of their *raison d'être*.

It may be that latterly it has been halting between two opinions: a novel mode of dealing with Clark's process, more recently in operation on Banstead Downs—within another walk of this place—may have induced them to hesitate.

Of water less hard than that of Croydon—viz., the water of the Thames, the General Board of Health (of which your Vice-President, Mr. Edwin Chadwick, C.B., was a member), in May, 1850, reported—

"That its inferiority as a supply for domestic uses arises chiefly from an excess of hardness, rendering the water especially unfit for the following uses—viz., for cleaning the skin and for the ordinary purposes of washing, by occasioning an excessive consumption of soap; for the preparation of tea, by occasioning waste to the like extent: and for all culinary processes by diminishing their efficiency and increasing their expense."

They add, that the saving in soap from the use of soft water in the operation of washing would be probably equivalent to the whole of the money expended at present in the water supply—for, estimated at an average of 1*s* per head per week, the expense of washing linen and other clothes of the then population of the metropolis amounted to nearly £5,000,000 per annum.

They estimated the saving in tea from the use of soft water at about one-third of the tea consumed in the metropolis.

"That soft water would prevent those incrustations and deposits in boilers and pipes which render hard water unsuitable for manufacturing purposes."

"We therefore advise the rejection of all schemes . . . . which adopt, as sources of supply, the Thames and its tributaries of the same degree of hardness, *wells*, and *springs from the chalk* or other formations which impart the quality of hardness."

That was in 1850. In 1851 the Government appointed a Commission—consisting of the late Professor Graham, F.R.S., Master of the Mint; the late D. W. Allen Miller, M.D., F.R.S., Professor of Chemistry at King's College; and Dr. Hofman, F.R.S., Professor of Chemistry at the Royal College of Chemistry—to report upon the water supply of the metropolis.

This Commission, while confirming what was reported by the General Board of Health in relation to the waste and uncleanliness attending the use of hard waters, say of the chalk spring-water "AFTER BEING SOFTENED it is an extremely pure water. It appears to be considerably superior even to the soft water from the streams of the Surrey sands. The chalk-water *alone* is uniform in its excellence at *all times*, the sources of it lying beyond the influence of weather or season. In the judgment of the Commissioners, the SOFTENED chalk-water is entitled from its chemical quality to a preference over all others for the future supply of the metropolis. It is no longer possible to disregard chemical means of removing hardness, or to represent them as impracticable on a great scale; they place the question of water supply *upon an entirely new footing*"—(Sixth Report, p. 208.)

The hardness of these chalk waters (and the Thames is largely supplied with water from the chalk) is due to their containing lime in that combination with carbonic acid termed bi-carbonate of lime.

Dr. Clark's process may be said to consist in throwing out lime by means of lime; and the Report of the Royal Commission of 1868, says—at page 205:—

"The economy which carbonate of soda exhibits in comparison with soap as a softening agent is far surpassed by that which results from the use of lime for this purpose. The latter material costs only 8*d* per cwt. and this weight of lime will do the work of 20¼ *cwt. of soap* in softening hard water, or of 4½ *cwt.* of carbonate of soda."

As the prices at which soap and soda may now be purchased may be less than in 1874, when the Reports was issued, it is sufficient to state the respective quantities equivalent to the cwt. of lime costing 8*d*.

But, as Professor Frankland has recently remarked in an official report upon the metropolitan water supply, the water *must* be softened with something, before the soap can take any useful effect in washing. What that "something" commonly is, our laundresses—our "*blanchisseuses*" (a more expressive word) best know.

The way in which Dr. Clarke makes use of lime for this purpose may best be described in his own words:—

"In water, chalk is almost or altogether insoluble, but it may be rendered soluble by either of two processes of a very opposite kind. When burned in a kiln, chalk loses weight. If dry and pure, only nine ounces will remain out of a pound of sixteen ounces. Those nine ounces will be soluble in water, but they will require not less than forty gallons of water for entire solution. The burnt chalk is called quick-lime, the water holding the quick-lime in solution is called lime-water, and the solution thus made is perfectly clear and colourless.

"The seven ounces lost in burning the pound of chalk consists of carbonic acid gas.

"The other mode of rendering chalk soluble in water is nearly the reverse. To dissolve in the second mode, not only must the pound of chalk *not* lose seven ounces of carbonic acid, but it must combine with seven *additional* ounces of that acid. In such a state of combination chalk exists in the waters of London—dissolved, invisible, and colourless, like salt in water.

"A pound of chalk thus dissolved in 560 gallons of water would form a solution not sensibly different from the filtered water of the Thames in the average state of the river."*

If the forty gallons of clear lime-water be mixed with the 560 gallons of clear water in which a pound of chalk has been dissolved by the addition to it of seven ounces of carbonic acid, a haziness very soon appears; this deepens into whiteness, caused by the nine ounces of quick-lime entering into combination with the seven ounces of carbonic acid by means of which the pound of chalk was dissolved and rendered invisible in the 560 gallons of water—for by this combination of the nine ounces of quick-lime

* And 1 lb. in 400 gallons of spring water.

with those seven ounces of carbonic acid, a pound of insoluble, and so visible, chalk is formed; while the pound of chalk deprived of those seven additional ounces that rendered it soluble and invisible, becomes again visible, insoluble. Thus there are two pounds of chalk reproduced in a solid state by adding the forty gallons of lime-water to the 560 gallons of water containing the solution of bi-carbonate of lime.

But these two pounds of chalk are reproduced in infinitely minute crystals, and it is only after a considerable lapse of time that these subside to the bottom of the vessel, leaving the water beautifully clear above.

A small experiment will perhaps interest many who may never have seen the effect.

Although the waters of different localities differ in the proportion of bi-carbonate of lime they hold in solution, there need be no important difference or variation in the *quality* of the lime-water employed; there being a limit to the amount of quick-lime that water will hold in solution, and that may be taken as nine ounces in forty gallons, as explained by Dr. Clark.

Water dissolves up or absorbs lime but slowly unless it be present in very great excess; therefore at works where the process of Dr. Clark is in practical operation the lime-water tanks or reservoirs contain an enormous excess of lime, and the commotion formed by filling them is increased and maintained for a time by blowing in air by means of an air-pump worked by the steam-engine, or the rousing and mixing of the lime with the water may be performed by rotating arms and frames, worked by gearing, as at Mr. Homersham's smaller works for the Government on Shooter's Hill.

I have adopted this latter plan for the lime-water tanks in two places, and in others the air-pumps; and in others I have relied upon the injection of the water under pressure through perforated pipes laid in the bottom of the tank, as was formerly the method at Caterham; it is not so effective as is desirable, and has to be supplemented by hand labour.

The agitation is maintained for about thirty or forty minutes and then discontinued, and in the course of a few hours the excess of lime falls to the bottom, leaving the clear solution of lime, or "lime-water," with which to operate upon the hard water to be softened.

I am not aware if any ready means of testing the comparative strength of the lime-water is commonly provided; but I believe not. It would appear to be useful to do so; because, by the ordinary way of carrying out the process, it is only when the whole of the day's supply has been treated that it can be determined whether or not a due proportion of lime-water or of lime in solution has been employed.

There is this, however, to be said: that there is little if any risk of any appreciable excess of lime being introduced—certainly no such proportion as is now commonly administered to infants as a preventive of, or corrective to, acidity. Of course an insufficient dose of the solution of lime would leave the softened water less soft than it might have been.

The mixing of the two waters is carried out in large reservoirs corresponding in capacity to the daily supply required; and as the subsidence of the particles of chalk is not completed under many hours, at least a pair of such reservoirs is needed, and I believe a third is commonly provided, into which the cleared lime-water is lowered from near the surface by the mouth of a pipe sustained by a float.

Now, the amount of space occupied by these reservoirs has practically excluded Dr. Clark's process from establishments in which it might otherwise have been very usefully applied, in economizing fuel very largely, by removal of the non-conducting substance that adheres to the interior surfaces of steam-boilers fed with water containing bi-carbonate of lime.

The woollen manufacturer and dyer, the calico printer and the paper manufacturer, and many others, suffer in the technicalities of their trades from the presence of carbonate of lime in the water they largely employ.

This brings me to the mentioning of a method of treating large quantities of water within a small space, that I have ventured to style the "Porter and Clark" process. In a little *brochure* I prepared for the occasion of the Conference on the National Water Supply, at the house of the Society of Arts in May last—and some copies of which are in the room to-day—will be found more details of it than time will allow me to read.

Now, it is far from a *new* idea, that, seeing within how short a space of time the chemical action of the lime-water upon the solution of bi-carbonate of lime is completed, the chalky product should be separated by filtration, and the process carried on continuously; thus avoiding the occupation of the considerable space, not to speak also of the considerable cost, demanded by and attending the provision of reservoirs, in duplicate, of capacity equal to one day's supply of water.

If the chemical action can be completed within twenty minutes, why not provide a vessel, or a pair of vessels, of a corresponding capacity, rather than a pair of reservoirs each of a capacity equal to twelve hours or more?

Dr. Clark, in his patent, appears to have contemplated filtration, but without hinting by what means, and, although in the interval some patents have been taken out with this object, nothing appears to have been actually done—the difficulty of cleansing the various filtering media proposed from the accumulating deposit of the infinitely minute atoms of chalk, and the cost of renewing them, having probably been deemed insurmountable.

In 1876 my attention was drawn to the subject, and the non-success of an apparatus applied to soften and filter the water of a large manufactory I was acquainted with, led me to consider the adaptation of an apparatus of which many types have been applied to purposes of a different kind.

My experiments were most successful, and were hardly matured when they attracted the notice of the Middlesex magistrates, then considering, under the advice of their Consulting Engineer, Mr. F. J. Bramwell, F.R.S., the question of softening the water of their new asylum on Banstead Downs.

After a demonstration at Banstead, upon a scale of 2000 gallons per hour, Mr. Bramwell advised the adoption of my method for softening and filtering 60,000 gallons per day.

At the same time, Messrs. Giles and Gough, architects of the Kent County Asylum, recommended its adoption there to the extent of 50,000 gallons per day.

My system has been in operation at both places for more than two years: the plant at Banstead being contained within a room twenty-one feet square, and at Chartham within a room of eighteen feet square.

The water at these places is of the same character as the Croydon water, from deep wells in the chalk—their hardness is about seventeen degrees, and this is reduced by the process to three and a half degrees.

A more recent example of my system, embodying some improvements in detail dictated by experience, has been for nine months in operation at the paper mill of Mr. Lloyd at Sittingbourne. This is also chalk spring water. The quantity for which the plant is designed is 120,000 gallons per twenty-four hours, the mill working night and day. This necessitates two lime-water tanks, but the whole plant is contained within a corner of a large warehouse, and occupies an area of twenty-seven and a-half feet by twenty feet.

This quantity of water, treated within twenty-four hours and within the space named, is, as I have been told, the same quantity as treated within twelve hours daily at Caterham Waterworks, which I recently visited. Those works have been, as to subsiding or settling tanks, greatly enlarged, and occupy a space that would be inadmissible in most manufactories; and this brings out the practical difficulty that has operated to preclude the adoption of Dr. Clark's process for the object to which he gives the first place in the title of his patent—viz. "*Manufactories*."

Taking, again, the 120,000 gallons treated daily at Caterham on a very extensive area, as a standard of comparison, I am now preparing the necessary plant for treating 144,000 gallons by day and 144,000 gallons by night—*i.e.*, 200 gallons of water per minute continuously, within a room thirty feet by forty feet, and this room will be above that which contains the engines which raise the water from a well 500 feet in the chalk. This is at Silvertown, near North Woolwich, for the India-rubber and Telegraph Works Company.

In the same neighbourhood, at the sugar refinery of Mr. Duncan, my system of filtering water, in course of treatment by Dr. Clark's process, has been in operation for more than two years.

All these applications in manufactories have for their object the saving of fuel; and I trust that the confession will not draw upon me the reproof of this meeting upon the ground of its not being a Sanitary question interest. I should at least claim to be a worthy disciple of Professor Clark and member of this Institute in that I had brought his process into operation to mitigate the poisonous effect of the consumption of large quantities of fuel, upon the atmosphere of towns and cities. This will appear in connection with the economical aspect.

At one of the establishments I have mentioned there are upwards of twenty steam boilers of large dimensions, consuming more than four hundred tons of coal weekly. It has been necessary to keep a set of men continuously occupied in removing the incrustation of lime, derived from the chalk water, at a cost in wages of £10 per week, while the use of two boilers undergoing the operation is meanwhile lost. Working night and day—it is only at long intervals that a refitting or overhauling of the machinery and boilers can be thoroughly done: when that occurs, and all the boilers are started freshly freed from scale or "fur"—it is found that about sixty tons less of coal are consumed than during the week when they were last at work. Thus, the SANITARY and *economic* interests combine.

Dr. Clark's process has been, save for a temporary experiment many years ago, confined to the treatment of waters free from organic matter and from alumina or earthy matter in suspension. In short, it is nowhere applied to river or open reservoir or pond water, for it has been found that a proportion of the chalk sufficient to produce a dulness in the appearance of the water remains a long time in suspension in combination with those other matters. Subsequent filtration would be necessary, or a very extended system of "subsidence" reservoirs.

The Swindon Water Company were much troubled by the dulness of the water they collect in their reservoir from the surface springs with more or less—according to the rainfall and snow—of surface water from a wooded ravine above, which gives also contributions of vegetable and earthy matters. They had no filtering beds, and the contracted space and the situation made them difficult of application.

Having visited the Canterbury Waterworks in order to see Dr. Clark's process, the directors subsequently visited the Banstead Asylum and Mr. Duncan's works, and inspected my system of filtration of water under treatment by Dr. Clark's process. They saw that, by my method, the fine precipitate of crystals of chalk alone served as the medium of filtration upon cloths of cotton twill placed like a succession of towels upon "towel-horses" and separated by chambers and compartments of about an inch in thickness, each compartment in the series, fed by a common channel, being a complete filter in itself—and giving off its separate quota of filtered soft water to an outlet common to all.

They recognized at once that this beautifully pure filtering medium arresting such infinitely minute atoms as those produced by the lime-water process, would certainly arrest therewith whatever of vegetable or earthy matter might be present in their reservoir water.

They determined upon adopting my process.

The work has been excellently carried out by the Great Western Railway Company's establishment, and the mixing tank and filters for treating 20,000 gallons an hour, or 250,000 gallons per day, are contained within a building sixty-one feet in length by eighteen feet in width and thirteen feet high in the walls; the pair of lime-water tanks of plate iron thirty feet by fifteen feet, and eight feet in depth are placed upon the higher ground outside; the whole being upon the slope of a hill and supplied by gravitation of the water from the reservoir above.

Some details will be found in the little printed description of the Porter-Clark process in the room.

Nothing can be more beautiful than the softened and filtered water at Swindon; but it must be said that it has occasioned more trouble in changing the cloths of the filters than the water of the chalk wells—as indeed was to be expected; and long neglect of cleansing a reservoir situated as is that at Swindon would bring upon the company a corresponding difficulty with their filtration.

A difficulty of that kind manifested itself at the outset and was remedied, and for some time the Swindon filters gave less occupation to the one man and a youth in charge of them than the filters at Banstead to one man in charge there. Later, we have had great quantities of rain, over a long period, and Professor Frankland, in his official report of February last upon the metropolitan water supply, says:—"Owing to the frequent and heavy floods the river waters were often much polluted and difficult to filter, whilst the deep well waters maintained their usual brilliancy and purity." It is not claimed for the Porter-Clark process that it is exempt, when applied to river or to impounded waters, from those difficulties of filtration Dr. Frankland mentions as attending the ordinary systems. What is claimed for it is a degree of excellence in the clearness of the water treated by it hitherto unknown in any method of filtration conducted upon a large scale, together with an extraordinary economy in space, and an absolute security for the daily removal of the impurities arrested by the chemically pure crystals of chalk forming the filtering medium.

This is a feature of first importance. I noticed that in the discussion of health questions at the Social Science Congress, recently held at Manchester, Captain Douglas Galton remarked upon the evil that might be expected to result from filtering water through a continuously increasing deposit of impurities, as is the case with most house filters, and to some extent with the filter beds of the water companies supplying London with water. By my system, it becomes a question of wages certainly, but the filtration of water through its accumulating and decomposing impurity is out of question; the cloths, with their adherent deposit of carbonate of lime and impurities, are necessarily removed daily. If my softening and filtering house on a large scale has somewhat the

aspect of a manufactory, it may be said to be manufacturing purified water, soft and clear, at the cost of perhaps one-third of a penny per thousand gallons, when organized upon a large scale.

In saying this, I am not claiming that Dr. Clark's process, when supplemented by my own, will eliminate much of impurity in chemical solution.

Something in that way it may be expected to accomplish, aided as the lime process is by the constant agitation—ebullition, so to speak—of the water in the mixing tank produced by the pumping in of air to promote the chemical reaction.

In conclusion, I would say that, while hitherto speaking of large quantities of water, small quantities can be considerably softened and filtered by my method.

T. H. PORTER.