Sanitation by electricity : report II upon the manufacture of electrolysed salt water (chloride of sodium and chloride of magnesium) for disinfecting purposes : dealing principally with its stability, bacteriological results, some expert opinions, and cost of production / by Fredk. Wm. Alexander.

SECOND REPORT *after visit to Rolleville, near Havre.*

Metropolitan Borough of Poplar.

SANITATION BY ELECTRICITY.

REPORT--II

UPON THE

MANUFACTURE OF ELECTROLYSED

SALT WATER

(Chloride of Sodium and Chloride of Magnesium)

FOR DISINFECTING PURPOSES.

Dealing principally with its Stability, Bacteriological Results, some Expert Opinions, and Cost of Production.

BY

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PUBLIC HEALTH OFFICES,
BOW ROAD,
CORNER OF FAIRFIELD ROAD,
October, 1905.

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REPORT--II

UPON THE

MANUFACTURE OF ELECTROLYSED SALT WATER

(CHLORIDE OF SODIUM AND CHLORIDE OF MAGNESIUM)

FOR DISINFECTING PURPOSES.

Dealing principally with its Stability, Bacteriological Results, some Expert Opinions, and Cost of Production.

"If we compare the action of the Hermite Solution as an antiseptic with carbolic acid, the superior efficiency of the former is so evident, even in solutions of relatively great dilution, that we are left in no doubt as to which is to be preferred."—LANCET COMMISSION.

To the Chairman and Members of the Public Health and Housing Committee.

GENTLEMEN,

Together with the Chairman of the Public Health and Housing, Electricity and Works Committees and the Electrical Engineer, I visited the works of M. Hermite, at Rolleville, near Havre. We were also accompanied by Mr. MCCLELLAND, the Superintending Electrical Engineer of Messrs. GEIPEL & LANGE.

Mr. BOWDEN, the Borough Electrical Engineer, will present in detail his report to the Committee as to the working of the plant.

Electrolysed salt water being so easily produced, it may be asked why so easily obtained a disinfectant has not been in more general use. This may be attributed to difficulties which were encountered in the past, viz.:—(1) Sanitary authorities possessing no electrical plant; (2) difficulties encountered in its preparation;—the electrodes not acting properly—but this difficulty has been met, for the apparatus as now made requires no attention, it is practically automatic; (3) the deterioration of the fluid; this has also been dealt with by making the

fluid from Chloride of Magnesium and Chloride of Sodium at high strengths. A preservative can also be added and the fluid put into dark coloured bottles with corks dipped in paraffin wax, then it will keep its strength indefinitely.*

It is well to bear in mind that when the fluid is made at high strengths the objectionable surplus of the Sodium Chloride which has acted as the conductor and remains in the fluid is advantageously diminished when the fluid is being diluted to lessen the amount of available chlorine.‡

Dr. RIDEAL "On the Sterilization of Effluents" says "Chlorine and chlorine oxides are as powerful as ozone, are easily soluble and generally more manageable."

It has been stated that "A fault of the Hermite process was that it failed to sterilise the interior of solid stools," but is there any known disinfectant which will do this, I know of no disinfectant, with such material it must be always necessary to break it up, or comminute it, or hydrolyse it, but so long as such matter is kept covered with disinfectant, and removed as soon as possible from the house, a great object is attained.

It is not proposed to deal with sewage effluents in Poplar but to render fæces innocuous until conveyed to the sewer where they become broken up and the disinfectants will then be free to deal with it, particularly if sewers are flushed from time to time with the fluid.**

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* There is no need really to use a preservative, as the fluid can be made at high strengths and will keep for days. There is no necessity to supply it in dark coloured bottles, for the public can bring their own bottles; but a stock will no doubt have to be kept for persons who cannot afford to buy a bottle, and dark coloured bottles can be obtained for 1d. each, 25 ozs., instead of the 16 ozs. bottle which at present costs 2d.

‡ It must be remembered as mentioned in my first report, the compound of chlorine in the fluid is not hypochlorite of soda, but hypochlorous acid, made from the chloride of magnesium, which has been converted into hypochlorite of magnesium, and its oxidising power is expressed by the quantity of available chlorine present which can be easily ascertained by the arsenious acid test. The chloride of sodium (salt) acts as the conductor for the electric current

** "M. Hermite's proposal is to establish a producing centre in the towns and to supply the liquid through pipes into all the streets and houses much in the same way that water and gas are at present supplied. The adoption of such a scheme in any place would no doubt lead to a sanitary condition of things hitherto unreached, but many excellent advances could be made in the same direction, it should be remarked, if cost were not an item which so often bars the way. Apart, however, from such a scheme, there is no doubt that the production from sea water of a powerful bleaching agent and deodorant is an innovation which should afford very material aid to sanitary progress. Thus for many purposes the substitution of electrolysed sea water for other and more expensive agents in our seaside towns and villages would doubtless confer many advantages. It could be used, for example—with desirable effect, doubtless—to flush the headings of drains and sewers; it could be discharged into sewage outfalls; and, lastly, the system could be applied on a small scale for the sanitary treatment of hospitals, barracks, &c., by means of an automatic electrolyser worked from a central electrical supply."—*Lancet Commission.*

All disinfectants will only exercise a sterilizing influence on external portions of solid substances, there must be intimate admixture, to secure sterility throughout the matter.

The usual method of testing and comparing disinfectants, consists in exposing for a given time cultures or emulsions of a particular microbe to dilutions of disinfectants. This is of value in comparing with one another, various disinfectants or their dilutions and affords a sufficiently reliable index of the efficacy and power of a given disinfectant in a definite dilution and for a definite time exposure; but it is well known that microbes to be acted upon by the disinfectant are embedded in, surrounded by and mixed with various materials: therefore, when making tests with any particular material, *e.g.*, pus, or blood, or fæcal matter, it is necessary to *intimately mix such material with the disinfectant* in order to compare the culture with the control culture: that is to say, with the culture which has been taken from the same prepared source and to which no disinfectant has been added: therefore it is absurd to state that disinfectant fails because it does not sterilize the interior of a hard stool.

The following extracts from the report of the Lancet Special Analytical Sanitary Commission on the Hermite process of Sewage Treatment by Electricity will inform the Committee respecting the germicidal value of the electrolysed salt water disinfecting fluid and will confute the presumption that the fluid has insufficient disinfectant power and is evanescent*. Some other expert opinions are also appended.

Respecting the stability of electrolysed salt fluid there is no possible doubt that electrolysed sea water, on account of the organic matter, is not so stable as electrolysed solutions of chloride of sodium and chloride of magnesium. It appears that from some sources there is disbelief in the power of a disinfectant fluid made by such simple and cheap means as electrolysing salt water, but the fact is lost sight of that in electrolysing solutions of salt water (not sea water) the available chlorine can be raised to a high per centage by using strong and stronger solutions and adopting means of keeping the electrical apparatus used in its generation cool. I saw at Rolleville a solution of over 8 grammes available chlorine per litre. This solution had been made some months and was originally 10 grammes. The strength of the solution which I suggest to be made for disinfecting purposes so far as the Public Health Department is concerned is 4 grammes of available chlorine per litre, which can be reduced by dilution by the public for ordinary purposes with eight times the amount of water and by so giving the public a solution this strength there will be no need to apply to the depots every day, but if it be necessary to store the fluid, means can be adopted as mentioned later on to ensure its stability although for all practical purposes it is quite stable enough.

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* In the tables the positive sign means growth, negative sign absence of growth after addition of electrolysed fluid.

STABILITY.

"It retains its oxidising properties for a considerable time, but a gradual diminution in strength takes place, as is illustrated in the following results obtained at varying times with the same sample :—

Analysis 3.

Original strength equal to	...	0·60	gramme Cl	per	litre
Next day	...	0.594	,,	,,	
Eight days	...	0·523	,,	,,	
Twelve days	...	0·501	,,	,,	

The sample referred to above was kept in an ordinary stoppered Winchester quart bottle, but the same sample stored in a carboy of ten gallons capacity showed at the end of twelve days a strength of 0·459 gramme Cl per litre. It is well to point out in this connexion that in the event of the system being applied to the needs of a large town the electrolysed fluid need not be stored, because the yield of liquor could be adjusted exactly to meet the daily demand, so that loss from storage would be obviated. The loss, however, in a few days appears to be small."*

—*Lancet Commission.*

. . . . . .

"Stable as Hermite fluid of good strength by itself is, it undergoes rapid diminution in chlorine strength when diluted with sea water."—*Lancet Commission.*

. . . . . .

"Although Hermite fluid may be diluted, *without losing strength, with tap water*, yet sea water could never be used as a diluent, since it rapidly reduces the strength of the solution ; and, secondly, that a considerable part of the energy spent in the electrolysis of sea water must first be appropriated by certain constituents (probably organic) which exist in fresh sea water. Further, electrolysed sea water increases in stability in proportion to its strength, and *vice versa ;* solutions below 0·25 Cl per litre rapidly lose oxidising power."—*Lancet Commission.*

The proposed Electrolyzed Disinfecting Fluid will not be made from sea water, but from a solution containing Chloride of Sodium and Chloride of Magnesium, which is *far more stable than sea water*, owing to the presence of organic matter contained in the latter. Moreover, if it be necessary to store the fluid made from Chloride of Sodium and Chloride of Magnesium, M. Hermite has informed me of a chemical which can be added to preserve the stability of the solution indefinitely and I may also add I have from another source obtained the like information.

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* This refers to electrolysed sea water the stability of which is not coefficient with electrolysed artificial brine.

When at Rolleville I promiscuously took a bottle of fluid out of the store and used about a teacupful of its contents upon some fæcal matter from a cesspool which emitted a *terribly fierce* odour. The deodorising effect was instantaneous. The remaining fluid in the bottle was immediately tested with the arsenious acid test and found to be just over 2 grammes of available chlorine per litre.

Bottles of electrolysed salt water (Hermitine) have been in my office for three months, the fluid was supplied as containing 2 grammes of available chlorine per litre. I have recently tested this fluid with the arsenious acid test and found it to be up to the standard, even one bottle which had been opened and recorked also stood the test. These tests quite prove the stability of the fluid for all purposes so far as the Borough of Poplar is concerned.

BACTERIOLOGICAL.

"The time element, as will be seen in our experiments, exerts an all-important influence on the results obtained, as if the available chlorine is present in very small amount the organisms may be able to increase in number, whereas if the solution be stronger the antiseptic action continues to operate and their number is reduced."—*Lancet Commission.*

. . . . . .

"In the case of the bleaching powder solution it is at once apparent that the immediate action on the organisms present is not nearly so great as in the case of the Hermite solution, where even in five minutes, the majority of the organisms present (probably all those vegetative forms which were freely exposed to its action) are at once killed off."*—*Lancet Commission.*

. . . . . .

"In making a bacteriological analysis of fluids and material which contain so *powerful an antiseptic as the Hermite Solution* is maintained to be, it is obvious that our first object must be to ascertain precisely the influence which the addition of this fluid exerts on our normal cultivation media."—*Lancet Commission.*

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"We append the following tables, which indicate the proportions of chlorine in which (the figures being calculated on the supposition that the medium acts merely as diluent and that no chemical changes intervene) the different organisms are inhibited or permitted to grow.

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* In the report of the Lancet Commission are given elaborate tables shewing when the hermitine was mixed with fluid stools how the number of colonies was reduced.

Table I.

Quantity of Hermite Solution required to be added to Gelatine to prevent the Growth of the following Micro-organisms.

Gramme of available chlorine in Hermite solution per litre.	Staphylococcus aureus.	Micrococcus prodigiosus.	Cholera.	Anthrax.	Mixture of organisms from stool.	Typhoid.	Diphtheria.
0·250	—	—	—	—	—	—	—
0·200	+	+	—	—	+	...	...
0·160	+	+	+	+	+	—	—
0·115	+	+	+	+	+	+*	+*
0·090	+	+	+	+	+	+*	+*
0·060	+	+	+	+	+	+*	+*

* Very small colonies were recognised by means of the microscope after a week's incubation.

Table II.

Quantity of Hermite Solution required to be added to Broth to prevent the Growth of the following Micro-organisms.

Gramme of available chlorine in Hermite solution per litre.	Potato bacillus.	Staphylococcus aureus.	Typhoid.	Micrococcus prodigiosus.	Cholera.	Diphtheria.	Anthrax.
0·250	+	...	—	—	—	—	—
0·200	+	...	—	—	—	—	—
0·160	+	...	—	—	—	—	—
0·134	+	...	—	—	—	—	—
0·115	+	+	+	—	—	—	—
0·090	+	+	+	—	—	—	—
0·060	+	+	+	+	—	—	—
0·047	+	+	+	+	—	—	—
0·025	+	+	+	+	...	+	—
0·012	+	+	+	+	...	+	+

Lancet Commission."

"The contents of both the drum and syphon . . . . consisted of slightly turbid fluid, which exhaled a strong sweetish, chlorous odour and was not in itself at all disagreeable; there was certainly an entire absence of the usual fæcal odour."—*Lancet Commission.* . . . . . .

"We have never, however, obtained colonies of bacterium coli communis (the characteristic organism occurring in stools) from the samples taken . . . ; this we regard as a fact of the utmost importance from a practical point of view, for if this organism is unable to escape the action of the Hermite solution it is exceedingly improbable that bacillus typhosus, or still less the bacillus of cholera or diphtheria, would be able to run the gauntlet. The necessity, indeed of killing spore-bearing organisms in the case of sewage is not very obvious, as none of those disease germs with which we are wont to associate danger from sewage are recognised as being able to form spores."—*Lancet Commission.*

. . . . . .

"We have, however, been forced to the conclusion that titration of the Hermite solution when mixed with organic matter does not afford a true index of its antiseptic value."—*Lancet Commission.* . . . . . .

"The Hermite solution did not appear to become rapidly exhausted, as after forty-eight hours it still retained its characteristic odour, whilst no objectionable fæcal smell was to be recognised."—*Lancet Commission.*

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TABLE VIII.

Antiseptic Action of Hermite Solution diluted with Distilled Water.

TYPHOID.

Available gramme of chlorine present per litre.	Immediate.	Five minutes.	Ten minutes.	Fifteen minutes.	Thirty minutes.	One hour.	Twenty-four hours.	The original dilutions of Hermite fluid were re-inoculated with B. typhosus on the fifth day, and after standing twenty-four hours were tested by inoculations into broth.
0·60	+	—	—	—	...	...	...	...
0·30	+	—	—	—	...	...	...	...
0·30	...	—	...	...	...	...	—	+
0·20	+	—	—	—	...	...	...	...
0·17	+	+	—	—	—	...	...	...
0·15	+	+	+	+	...	...	...	...
0·15	...	+	...	+	...	...	—	+
0·13	+	+	...	...	...	...	...	...
0·12	+	+	+	+	...	...	...	...
0·10	...	+	...	...	+	+	—	+
0.05	...	+	...	...	+	+	+	+

Table IX.

Antiseptic Action of Hermite Solution diluted with Distilled Water.

Cholera.

Available gramme of chlorine present per litre.	Immediate.	Five minutes.	Ten minutes.	Fifteen minutes.	Thirty minutes.	Forty-five minutes.	One hour.	Twenty-four hours.	Ninety-six hours.
0·6	—	—	—	—	...	...	...	...	...
0·50	—	—	—	—	...	...	...	..	...
0·30	—	—	—	—	...	...	...	...	...
0·25	—	—	—	—	...	...	...	...	...
0·20	—	—	—	—	...	...	...	...	...
0·18	—	—	—	—	...	...	...	...	...
0·15	—	—	—	—	...	...	...	...	...
0·135	—	—	—	—	...	...	...	...	...
0·120	—	—	—	—	...	...	...	...	...
0·120	...	—	—	...	...	...	...	...	...
0·100	—	—	—	—	...	...	...	...	...
0·075	...	—	—	—	...	...	...	...	...
0·060	—	—	—	—	—	...	—	—	—
0·058	...	—	+*	—	—	...	...	...	—
0·040	...	—	—	—	—	...	...	...	—
0·025	...	+	...	+	+	+	+	+	+
0·0125	...	+	...	...	+	+	+	+	+

* The positive result recorded in this case, in view of the others being negative, is almost certainly due to the drop taken for inoculation having contained a small fragment of culture, which would undergo sterilisation with much greater difficulty than when the organisms were broken down into their discrete members.

TABLE X.

Antiseptic Action of Hermite Solution diluted with Distilled Water.

DIPHTHERIA.

Available gramme of chlorine present per litre.	Immediate.	Five minutes.	Ten minutes.	Fifteen minutes.	Thirty minutes.	Forty-five minutes.	One hour.	Seventy-two hours.
0·45	—	—	—	—	...	...	...	...
0·225	—	—	—	—	...	...	...	...
0·150	—	—	—	—	...	...	...	...
0·150	...	—	—	...	...	...	...	—
0·110	—	—	—	—	...	...	...	...
0·100	...	—	...	—	...	...	...	—
0·090	+	—	—	—	...	...	...	...
0·050	+	—	—	—	...	...	...	...
0·050	+	—	...	—	—	...	—	—
0·033	...	+	...	+	+	..	+	—
0·020	...	+	...	+	+	...	+	+
0·0125	...	+	...	+	+	+	+	+

TABLE XII.

Antiseptic Action of Hermite Solution diluted with Distilled Water

STAPHYLOCOCCUS PYOGENES AUREUS.

Available gramme of chlorine present per litre.	Immediate.	Five minutes.	Ten minutes.	Fifteen minutes.	Forty-eight hours.
0·53	—	—	—	—	...
0·265	—	—	—	—	...
0·176	+	—	—	—	...
0·132	+	—	—	—	...
0·106	+	+	—	—	...
0·100	+	+	—	+	+
0·060	+	—	+	—	...
0·050	...	+	...	+	+
0·033	...	+	...	+	+
0·025	...	+	...	+	+
0·012	...	+	...	+	+

TABLE XIII.

Antiseptic Action of Hermite Solution diluted with Distilled Water.

ANTHRAX BACILLI (SPORE-FREE).

Gramme of available chlorine in Hermite solution per litre.	Immediate.	Five minutes.	Ten minutes.	Fifteen minutes.	Thirty minutes.	Twenty-four hours.
0·500	—	—	—	—	...	...
0·270	—	—	—	—	...	...
0·250	...	—	...	...	—	...
0·135	—	—	—	—	...	...
0·125	...	—	...	...	—	...
0·100	—	—	—	—	...	...
0·060	+	—	—	—	...	...
0·060	...	—	...	...	—	...
0·030	...	—	...	...	—	...
0·025	...	—	...	...	—	...
0·015	...	—	...	...	—	...
0·007	...	+	...	...	—	...

Lancet Commission.

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TABLE XIV.

Antiseptic Action of Hermite Solution on Anthrax Spores.

Gramme of available chlorine in Hermite solution per litre.	Thirty minutes.	One hour.	Twenty-four hours.
0·75	—	—	—
0·50	—	—	—
0·35	—	—	—
0·25	+	—	—
0·15	+	+	+

Lancet Commission.

. . . . . .

"If we compare the action of the Hermite solution as an antiseptic with carbolic acid, the superior efficiency of the former is so evident, even in solutions of relatively great dilution, that we are left in no doubt as to which is to be preferred. The only substance used as an antiseptic, which operates in solutions of such great dilution, is corrosive sublimate, $HgCl_2$, and, although the laboratory experiments might appear to give it a certain advantage, we are confident that the facility with which it unites with organic bodies, and thereby becomes inert, would render it very much less efficacious than the Hermite solution for general use as a practical disinfectant. The electrolysed sea water or our "artificial" Hermite solution appears, indeed, while exerting a specific disinfecting action on the organisms, at the same time to be used up and destroyed to a much less extent by the organic matter present than any other disinfectant with which we are at present acquainted."

"In applying the results which we have obtained from our examination of the Hermite system carried out on the spot and our more extended laboratory experiments, it must first be stated that all investigators who have occupied themselves with the question of the sterilisation of stools have found it most difficult to render them absolutely sterile in a short space of time by the ordinary means available, and have accordingly addressed themselves more to the solution of the problem of what would be sufficient to free them from the pathogenic germs, such as those of typhoid fever and cholera, which might be present. We are quite satisfied from our examination of the effluent . . . . that all such would be effectually dealt with, as the more resistant Bacterium coli commune appears to be destroyed. It is probable from a number of observations which we have made, which it is unnecessary for us here to record, that the titrations of the effluent do not really indicate fairly its antiseptic power, but that this is really much greater than the arsenious acid method would lead us to expect. It will also be noticed that the higher strengths of solution supplied from the distribution tanks do not so markedly raise the amount of available chlorine in the effluent as might be expected, and this is to be accounted for by the more unstable portion of the solution being at once converted into some other form, which, although not indicated by the arsenious acid titration may still be effective as an antiseptic. The bacteriological results also are not improved to such an extent as to warrant us in recommending the adoption of such strong solutions of the Hermite fluid, as this would necessarily entail no inconsiderable addition to the cost involved in the adoption of the system ; a strength of between 0·50 and 0·60 gramme chlorine per litre is all that we should consider necessary to effect the proposed objects of this method of sewage treatment."—*Lancet Commission.*

SOME EXPERT OPINIONS.

The deodorization of sewage with the electrolyzed fluid is immediate.—*Dr. Armand Ruffer.*

The sample does not smell like ordinary sewage and has not developed an offensive sewage smell after a week's keeping.—*Dr. Dupre.*

As a deodorizer the electrolyzed sea water is perfect. The deodorization is real, the smell does not return.—*Dr. Piton.*

The fæcal matters treated by the liquid of Mons. Hermite have been completely deodorised.—*Dr. Leon Padè.*

Sewage treated with a sufficient quantity of electrolyzed fluid of 0·75 of available chlorine or more per litre can be made quite sterile provided the fæces are well broken up and mixed with the electrolyzed fluid.—*Dr. Ruffer.*

The effluent was sterile with the exception of a few (less than half a dozen per C.C.) spores of bacillus subtilis and allied organisms which had alone survived. When we remember that 1 C.C. of sewage contains at least 1,000,000 bacteria, this result is truly astonishing.—*Dr. Ruffer.*

We made some experiments with some putrid sewage taken at the Metropolitan Outfall at Crossness and we found that this was comparatively easily sterilized and deodorized; one volume of 0·75 per 1000 of the Hermite Fluid being sufficient to sterilize an equal volume of this sewage.—*Dr. Ruffer.*

Ordinary raw sewage of London, Manchester and other towns that I have examined contains between 3,000,000 and 10,000,000 of bacteria per c.c.; this "treated" sewage effluent of Worthing contains only 800 to 1000 microbes per 1 c.c. It follows that there has been effected by the mixture of the Hermite Solution a remarkable reduction in the number of living microbes. After treatment of the original cultures with the same bulk of Hermite Solution for 20 minutes, similar plates were made and the number of colonies coming up in these plates was compared with those of the previous control plates. It was found that by the Hermite Solution the number of living microbes was reduced something like over 100 times.—*Dr. Klein.* *see footnote.

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*Dr. Klein would have obtained complete sterilization with a little more liberal use of the Hermitine.—*M. Hermite.*

The electrolized sea water is a perfect deodorant and an excellent antiseptic which rapidly destroys the most hardy micro-organisms, always assuming a good contact between the micro-organisms and the electrolized solution.—*Dr. Piton.*

The tests relative to this question (complete sterilization) were made at different times during the installation at the Figaro with samples taken from the diluting syphons. The results in every case—five trials—shewed the complete sterility of the liquid at the moment of its issue from the diluting syphon. The strength of the solution in this installation was 0·5 per litre.—*Dr. Christmas.*

The fæcal matters treated by the liquid of M. Hermite have then been completely sterilized.—*Dr. Leon Padè.*

Electrolyzed sea water is a most powerful microbicide.—*Havre Commission.*

A contact of four to six hours (with electrolyzed seawater) is then necessary under these conditions to kill the spores of subtilis. To obtain the same result with a solution of sublimate of 1 in 1,000, a contact of 24 hours was required. Carbolic acid (1 in 20) only killed the spores after several days.—*Dr. Christmas.*

Electrolyzed sea-water is relatively stable, and the higher the strength the greater the stability.

At 1 gramme per 1,000 it loses $\frac{4}{1000}$ per day. *
,, 0·75 ,, ,, $\frac{5}{1000}$,, *
,, 0·50 ,, ,, $\frac{20}{1000}$,, *

The mixture of electrolyzed sea-water with fresh water is as stable as if two electrolyzed solutions were mixed together, showing the possibility of transporting a concentrated solution to a distance and reducing the strength with fresh water at the point required for use.—*Dr. Piton.*

* This is Sea Water.

Extracts from Dr. Piton's Report made to the Municipal Council of Brest on Electrolysed Sea Water.

"One can assert that the deodorization of fæcal matter is instantaneous.

On several occasions I have collected in a test-glass both hard stools and soft, and liquid ones.

In each case deodorization took place immediately the electrolysed solution has been poured on the matter. It may be objected that the smell of chlorine only "masks" the smell, which would return later.

The supposition is erroneous.

The deodorization is real, the smell does not return.

If the stool is hard, one may break it up in the test-glass after pouring the solution over it; there is no return of the odour. Soft or liquid stools, allowing of the solution mixing more fully with them, are even more easily deodorized.

I consider this rapid deodorization to be an excellent argument in favour of the electrolysed solution."

. . . . . .

"*Action upon fæcal matter.*—It is not sufficient to know the effect of an antiseptic on a simple culture in Broth tubes: it must be studied in its effect on the surroundings of the micro-organisms and, in the present case, on fæcal matter and the microbes they contain. These matters afford considerable protection to the microbes by enveloping them with the residues of digestion; albuminous, and above all, fatty substances, which enter into their composition, hinder the contact of the antiseptic with the micro-organisms."

. . . . . .

"*Effect on liquid fæces.*—At the same time that I experimented on the effect of the electrolysed solution upon solid stools, I studied also the effect on liquid stools, and specially typhoid ones.

. . . . . I added to a typhoid stool an equal volume of electrolysed solution of 1 gramme strength: I only allowed it to be in contact for five minutes.

I made two Broth plates; the one with the natural typhoid stool of which I had kept a part, the other with the stool which had been in contact with the electrolysed solution. At the end of four days the first plate began to show, and soon was crowded with innumerable colonies.

. . . . . that is to say nine days after the impregnation, a small colony hardly visible, was found on the second plate, no other has shown itself since. The colony that was found was neither of the typhoid bacillus or coli-bacillus type.

This test is evidence in support of the rapidity of the action of the electrolysed solution when a perfect contact with the material to be sterilized can be attained."

. . . . . .

"Urinals, house refuse, and bilge-water, in ships, are quickly and effectively disinfected."

. . . . . .

"The experiments that I made lead me to the conclusion—
That electrolysed sea-water is a perfect deodorant and an excellent antiseptic, which rapidly destroys the most hardy micro-organism, always assuming a good contact between the micro-organism and the electrolysed solution."

COST.

With Sodium Chloride (salt) at 40/- per ton and Magnesium Chloride at £5 per ton*, 185 gallons of electrolysed fluid at a strength of 4 grames per litre can be produced in eight hours at a cost of 9/6 :—

	s.	d.
Sodium Chloride (salt) ...	1	6
Magnesium Chloride ...	1	0
Electricity	7	0
185 gallons of Electrolysed Fluid at 4 grammes per litre	9	6 *

The price of the Electricity is based upon a flat rate of 1½d. per unit, 56 units being required during a working day of eight hours. ‡

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* Ordinary Coarse Salt can be obtained for 24/- per ton and Chloride of Magnesium for £4 15s. per ton, therefore these prices will reduce the cost of production in this direction and consequently lessen the cost of the fluid.

‡ M. Hermite at our interview, hearing of the probable requirements of the district has since suggested the most appropriate electrodes accordingly. No Rheostat and no Motor Generator will be required; the current can be taken direct off the Borough Mains, 30 amperes at 230 volts. The Electrical Engineer deals with this matter in his report. The cost of the Electrolyser differs from the price which I stated in my former report, as then the requiremeuts of the Public Health Department were only being considered, and the strength of the solution was to be one gramme per litre. *(Footnote ‡ continued next page.)*

Out of the 185 gallons produced per day of eight hours, for the Public Health Department there will be a maximum demand of 60 gallons at a strength of 4 grammes of available Chlorine per litre, leaving 125 gallons at the same strength, or 10,000 gallons at ·05 available Chlorine per litre for the purposes of the Surveyors' Department for street watering**; but should it be necessary, the electrolysers can be worked the whole 24 hours, producing 555 gallons at 4 grammes per litre, at a cost of 28/6 (Salt being taken at 40/- per ton, and Chloride of Magnesium at £5 per ton).

Messrs. Geipel & Lange, the agents for M. Hermite, in a letter giving figures which will be dealt with by Mr. Bowden, the Borough Electrical Engineer also state:—

"We propose to supply four slate electrolysers of 10 sets of electrodes each, the solution running from one electrolyser to the other and the four electrolysers mounted in series and taking a current of 30 amperes and 230 volts."

"Therefore, we shall have 40 electrodes x 30 amperes, say 1,200 amperes hour at 0 gr. ·5 chlorine per ampere hour, that will give us 600 grammes of chlorine per hour, which is ample."

"This plant will use your current as you have it and will not require any cooling water."

"We will of course, supply you with a drawing of the installation and all necessary informations."

"We will undertake to supply the four electrolysers and a saturator for dissolving the salt F.O.B., London for the sum of £325."

It must be remembered, the main cost is due to using platinum for the electrodes, which metal is absolutely indestructible and will be always an asset to the Borough. The electrodes and other parts of the apparatus are not subject to wear and can only deteriorate through want of care. It is only necessary to keep the apparatus clean.

The cost of disinfectants at the instigation of the Public Health Department (not including the Works Department) last year was:—
Fluid, £220 6s. 11d.; Powder, £59 0s. 6d.; Bottles, £127 15s. 5d.; Bags, £24 15s.; Labels, £5 15s. 6d.; Corks, £18 15s.; Cotton Waste, £1 6s. 6d.; Total, £457 14s. 10d.

** Respecting the Maidenhead experiments, Dr. Rideal states:—"Experiments conducted by Prof. Robinson, Dr. Kanthack, and myself, a bad effluent was treated with one or two parts of Chlorine per 100,000 with very satisfactory results as regard bacteria." These quantities are equivalent to ·01 or ·02 per 1000. It is proposed to use the Fluid for street watering at a strength of ·05 per 1,000, by adding 5 gallons at 4 per 1,000 to 400 gallons of water, and enough can be made in eight hours for 25 water carts at this strength and possibly there would be 20 gallons at 4 per 1,000 left over daily from the Public Health Department's 60 gallons, which is a high figure for the daily demand.

I am, Gentlemen,

Your obedient Servant,

FREDK. WM. ALEXANDER,

Medical Officer of Health.

PUBLIC HEALTH OFFICES,

BOW ROAD, E.

October, 1905.

ADDENDA.

Since this report was presented to the Public Health and Housing Committee, Messrs. GEIPEL & LANGE, *inter alia*, in a communication state "we have made enquiries as to the cost of salt and Magnesium Chloride. The lowest prices we have received have been for common salt in 5 ton lots, delivered in bulk, Poplar Station, 17s. 2d. per ton in 5 ton lots; Magnesium Chloride, delivered on Wharf, London, £3 10s. 6d. per ton in 10 ton lots." Including cartage, salt will therefore cost £1 0s. 0d. per ton and Chloride of Magnesium £3 15s. 0d., which will materially lessen the cost of the fluid.

	s.	d.
Sodium Chloride (salt) ...	0	9
Magnesium Chloride ...	0	9
Electricity	7	0
185 gallons of Electrolysed Fluid at 4 grammes per litre	8	6

Which is a reduction in cost of one shilling for 185 gallons of fluid.