

# SECTION III.

## CHEMISTRY, METEOROLOGY, AND GEOLOGY.

### ADDRESS,

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ALTHOUGH having to preside over a section that includes three sciences, I must, at the outset, express a hope that no one will expect me to be three single gentlemen rolled into one, able to discourse on chemistry, on meteorology, and on geology. Rather must I follow the advice given to the cobbler, and stick to the last.

I may, however, claim some little connection with all the three branches of science, and it behoves me perhaps to make the most of this. The first of them, chemistry, was the first science that I studied, and once (a long time ago) I thought myself the happy possessor of some fair amount of theoretical knowledge of it. Since then, its language, and one may say its alphabet, has changed; and I should be very sorry to have to undergo an examination in its rudiments now-a-days.

Having led more or less of an outdoor life for nearly thirty years, I may be allowed to have some practical interest in meteorology, as well perhaps as a certain amount of weather-wisdom got by experience and by rough observation.

And here let me put in a plea on behalf of a much abused institution—our English climate, which I am disposed to look on as a fairly satisfactory arrangement; perhaps indeed it would be quite satisfactory if our American friends would leave us alone, or would treat us more justly, by now and then sending us some fine weather instead of always bad. It should be satisfactory to know that much of our bad weather is not a home product, but an importation. To those who would bask in perpetual sunshine, to my mind a most unpleasant way of

spending time, I would quote the words of Charles Kingsley, in his "Ode to the North-East Wind," giving his views of the relation of weather to health, which perhaps are not too well known to meteorologists :—

Welcome, wild North-easter !  
 Shame it is to see  
 Odes to every zephyr ;  
 Ne'er a verse to thee.

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Tired we are of summer,  
 Tired of gaudy glare,  
 Showers, soft and steaming,  
 Hot and breathless air.  
 Tired of listless dreaming  
 Through the lazy day :  
 Jovial wind of winter  
 Turn us out to play !

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Let the luscious South-wind  
 Breathe in lovers' sighs,  
 While the lazy gallants  
 Bask in ladies' eyes.  
 What does he but soften  
 Heart alike and pen ?  
 'Tis the hard grey weather  
 Breeds hard English men.

As for geology, the last-named science of our section, it is also the last science that I took up. It has since been my study, continuously, for some thirty-two years, and I am beginning to despair of ever knowing very much about it ; for its bounds are ever extending, and at such a rate that the ordinary human mind cannot keep up with it. Indeed, geologists have long been obliged, with comparatively few exceptions (of which I am certainly not one) to limit themselves to certain branches of their science. In my own case some of the more practical bearings of geology have been forced on my attention, by the more or less mechanical nature of much of the work that has fallen to my lot as an officer of the Geological Survey—work that consists essentially of recording facts, or, at least, of doing one's best in that way, some of her facts being much hidden by Dame Nature.

It has been my duty at times to work with Medical Officers, and this duty has been a pleasure also ; for it is pleasant to find one's own particular science of use beyond one's own immediate sphere of action. One of these occasions may fairly be alluded to here, as an example of the bearing of geology on large

problems relating to questions of health; in this case to the distribution of certain diseases in certain districts. I refer to the enquiry made by my old friend and fellow-student in geology, Dr. G. Buchanan, now the chief Medical Officer of the Local Government Board, on the Distribution of Phthisis as affected by Dampness of Soil. Having had to report on the effects of sanitary work in certain large towns, Dr. Buchanan unexpectedly found that where, from improved drainage, a decrease of subsoil water had taken place, there the consumption death-rate had also decreased, the most marked example being Salisbury, where the decrease was to nearly a half.

This result led Dr. Buchanan to think that, as artificial drainage caused so great an improvement, it might be found that in districts where, from natural causes, the subsoil was less saturated with water, the death-rate from consumption might be less than in districts where greater saturation occurred.

The further enquiry that was made for the purpose of testing this important question of course involved the examination, in some detail, of the surface-geology of the district selected, as being the one in which alone (at that time) we had the materials for such a work. This district included the whole of the counties of Kent and Surrey (leaving out London), with great part of Sussex, and the enquiry resulted generally in the conclusion that wetness of soil and prevalence of consumption go together.\*

Two of the chief problems in matters sanitary are to get good water and to get rid of bad water. Indeed, one may say that when these problems have been solved in any town, at least two-thirds of the work of sanitation have been done.

Our aërial friends may perhaps object to this, and may say that I should be contented with a half, air being of equal importance with water; but I hold that the objection would be itself aërial, and for this reason, that the questions of good and of bad air go together: you cannot get good air without getting rid of bad air, though it is possible of course to replace bad air by other equally bad, or even by worse. With water, however, the case is quite different: a town may have one of the best of water-supplies, but its bad water, that is its sewage, may be got rid of

\* For full details see Tenth Report of the Medical Officer of the Privy Council, pp. 57-110 (1868); for a shorter account, from a geological point of view, see *Geological Magazine*, Vol. vi. pp. 499-505.

in the worst way; and, on the other hand, another town may have the most complete arrangements for properly getting rid of its sewage, or even for almost doing without that article, but may have a very bad water-supply.

Again, water-supply and sewage must be questions of a more or less public kind, in large places; whilst air cannot be publicly dealt with to any such extent, except as part of sewage arrangements, the ventilation of houses not being yet within the ken of corporate bodies.

With regard to water, it is not only important that populous places should, in the first instance get a good supply; but also that it should be kept good, or, in other words, that sources of pollution should be religiously kept away, a process that entails a careful watch on the doings not only of one's own corporation, companies, &c., but on those of one's neighbours' besides. Undoubtedly the worst thing that can be done with water and sewage is to mix them.

The importance of a good water-supply, and the evil that may result from a bad one, have recently been brought before us in a paper by Mr. G. Higgins,\* which treats of the late outbreak of cholera in Spain, showing how its virulence went along with badness of water-supply, certain large towns having been but little affected as compared with others. The author's conclusion may be given in his own words:—"Broadly speaking, it would appear that in Spain this formidable disease never became truly epidemic or dangerous in any city in which there was a pure and good supply of water." In illustration of which, six places provided with good water (in one case a bad supply having been suppressed) are noticed as comparatively free from the scourge, whilst others, with a more or less contaminated supply, were severely visited. So marked, indeed, is this that Mr. Higgins thinks that "when it (cholera) gets possession of the water-supply of a city, no bounds can restrain it; there is but one resource, and that is cutting off the water."

This lesson should be taken to heart by our local governing bodies, who should jealously guard our water from contamination, or indeed from any risk thereof. The immediate saving of money, so popular a notion with many of these bodies, is really a small matter as contrasted with the danger to public health, which may often follow in a not far distant future, from the acceptance of schemes for sewage, for cemeteries, or for other such contaminating influences, on the ground that they "save the rates." I may bring to your notice some schemes, which, originating either in this way or from a want of forethought

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\* Cholera in its Relation to Water-Supply, *Nature*, 17th June, 1886.

as to their possible result (sometimes indeed from want of knowledge at the time), show the truth of Hood's lines, that

“ Evil is wrought by want of Thought  
As well as want of Heart.”

It occurred to me at first that it might be better to notice the following cases without giving the names of the places where they occurred; but second thoughts, which are proverbially best, suggested that a certain vagueness would result, which might decrease the effect of the whole. It is only fair to say that the cases brought forward are not meant as glaring instances of wrong-doing, actual or projected, some of them referring to comparatively trifling matters; but merely as examples of questionable proceedings of a kind that may often crop up and vex the sanitarian mind. They will be taken in the alphabetical order of the places of occurrence.

*Barnet.*—Twenty-one years ago an “Absorbing Well,” was made for the sewage of New Barnet. It was foreseen that it would hardly do to carry this into the Chalk, the great water-bearing bed of the district, and it was ended in sandy Tertiary beds, between the London Clay and the Chalk. As, however, water is sometimes got from those beds, this proceeding is not without danger. Moreover, there is also the danger of there being some communication between those Tertiary beds and the underlying Chalk, from which the water-supply of the place is got. I believe, however, that this sewage-well has been abandoned. If not it ought to be.

*Canterbury.*—This city is blessed with a good supply of water from the Chalk, got near the southern boundary, and softened. Lately however, some houses, draining into cess-pools, have been built near by, but unfortunately outside the boundary, and therefore beyond the jurisdiction of the city. Whether any pollution of the water may result is perhaps uncertain; but no one should be surprised to hear that the Water Company has expressed its displeasure at the proceeding.

*Fareham.*—A somewhat remarkable case of water-pollution has lately been under investigation at the Hampshire Lunatic Asylum, near this town. A bad outbreak of typhoid fever led the Board of Visitors to have a thorough investigation made, and one of our Fellows, Mr. Rogers Field, has, I think, satisfactorily traced its origin to pollution of the water-supply. Having a fair knowledge of the circumstances, I may give a summary of the history of the case, premising that the Asylum was established many years ago, when Sanitary Science had

hardly been invented, so that it is an example of the difficulties that authorities may meet with in old institutions:

1. A dry healthy site was selected on a low chalk hill, with a capping of gravel, and partly bordered by a stream.

2. A well was sunk, and a plentiful supply of good water was got at a moderate depth.

3. The sewage of the Asylum had to be provided for, and this was done, not unnaturally, by distributing it over parts of the grounds, all of which consist of Chalk, capped with gravel at the higher parts.

4. The hundreds of living lunatics in the Asylum having thus been cared for, it became essential also to think of those who died, and a Cemetery had to be established. This also is on the Chalk, and now contains more than 1,500 bodies.

5. The result of a careful investigation, from engineering, from chemical, and from geological standpoints, was to prove that the water of the well was contaminated (as might be expected), and it was shown that the underground flow from the neighbourhood of the cemetery and of the sewage-works was either naturally in the direction of the well, or had been artificially made so by pumping, which pumping, moreover, slightly affects the water-level in a piece of water further from the well than the polluting causes, proving that these are within the cone of exhaustion.

We hear much now-a-days of the germ-theory; but, as far as I know, it has not yet been extended to the propagation of madness; we have not yet heard of the *Bacillus* of lunacy. Should such extension be made, it would seem that the Asylum in question may bid fair to prosper, if increase of business means prosperity, until some other water-supply has been got, as, however, I have no doubt it will be.

*Sutton* (Surrey).—The Local Board of this place has lately brought forward a scheme for establishing a Cemetery on the Chalk, about three-quarters of a mile from the Waterworks, which get their supply from the Chalk. Strange to say, the Waterworks Company did not oppose the scheme (some ill-natured people said because some of the Directors are also members of the Local Board); but many of the rate-payers opposed it very strongly, being desirous of having water without risk of pollution. I have read the evidence that was given at a Home Office Enquiry, which is of course of the usual conflicting, and sometimes irrelevant, character, and was glad to find the voice of our member, Mr. Baldwin Latham, lifted up against the proposal, as one likely to cause pollution to the water-supply. You will be glad to hear that the Home Office has refused its sanction to the scheme, and perhaps sur-

prised to hear that the Local Board has started another, of just the same kind, for the establishment of a Cemetery within half a mile of the former proposed site, and like it, about three-quarters of a mile from the Waterworks; but with the further advantage of being close to the large Metropolitan Schools, where some 1,500 children are supplied with water from wells in the Chalk. Perhaps a reduction in the number, by means of a possible epidemic, is looked on as a method of affording relief to the rate-payers of London.

One cannot help wondering what would happen were the Waterworks in the hands of the Local Board, and a Company proposed to establish Cemeteries on either of the suggested sites!

The question of burying-grounds leads one to ask whether it is right that the living should be sacrificed to the dead? Will there never be an improvement in our present horrible way of dealing with the latter? That subject, however, it is not my business to discuss;\* enough to enter a protest against the establishment of cemeteries on great water-bearing formations, and near waterworks.

*Swaffham.*—One day when working on the Geological Survey in Western Norfolk, I had occasion to look at a certain chalk-pit within two miles of this little town, my interest in which was augmented by seeing, in the distance, signs of moisture in the bottom, where, from the height of the place, no such signs should be, the saturation-level of the Chalk not being near the surface. I hastened down hill to this quite unexpected occurrence, and suddenly found myself in ground soaked with moisture of a distinctly unpleasant kind! My nose (and most people can speak through the nose) said sewage! and I quickly evolved the theory that Swaffham drained itself into this chalk-pit, a theory that, unlike many others, survived the test of enquiry. Luckily this sewage-pit is not in the line of flow of underground water to the town, which is supplied from a well in the Chalk, and luckily, too, it is some way from houses. As, however, we know little about the distance to which sewage in bulk may flow underground with retention of polluting power, I look with some interest on the Swaffham experiment. Any one wishing to see this experiment will easily identify the spot, which touches a road, by scent.

*Tring.*—I will now allude to a case referring to surface water-supply, for information on which I am indebted to my colleague Mr. Jukes-Browne. Part of the drainage of this town is carried away by a sewer which empties itself into the canal-reservoir to

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\* It was the first subject discussed in Section I., p. 77.

the north. Before this sewer was made the reservoir received only spring-water, a matter of some importance, as some neighbouring villages drew their water from the stream that flows from the reservoir. After the turning in of the sewage, in summer, when the water in the reservoir was low, it stank abominably; and worse, diphtheria, typhoid fever, and other such diseases, were frequent in the villages. This has lasted for years; but I hear that the Local Board have at last adopted a scheme to treat the sewage by broad irrigation, on land between the reservoir and the canal, and that the process is to begin this month. Whether it will be perfectly effective or not may be a matter of doubt, and very likely the question of the water-supply of the villages may crop up again.

The course along which we have now gone can hardly be called a pleasant one. It is not, however, the object of this Congress to take you along such paths, but rather to show evil ways, and to lead to their improvement. Yet I would like to call your attention to a subject that will perhaps prove to be very important, and that, so far, shows that some processes in every day use in many waterworks may turn out to have a beneficial effect in a way never dreamt of when they were started. The processes alluded to are *filtration* and *softening*. The subject arises from a paper by Dr. P. F. Frankland, published only last July,\* in which it is shown that filtration not only fulfils its object in separating solid particles from water, but also reduces the number of micro-organisms in the water, the reduction going even to the extent of entirety at the very first, but, in most cases, greatly decreasing after prolonged action. Iron-sponge and coke are exceptions to the great decrease in this power, and are by far the most effective substances. It is noteworthy that this power of stopping the passage of micro-organisms is possessed by substances that have hardly any chemical action on water. Of course, Dr. Frankland's experiments emphasize the need of the frequent renewal of filtering materials.

It is found too that micro-organisms are thrown down from water by agitation with particles of solid matter; and here again coke is to the fore, closely followed by charcoal and by chalk. If, however, the water be left long with the deposit thus thrown down, a re-ascension of organisms, and their consequent multiplication, take place.

A like purification is also brought about by chemical precipitation, a fact of great practical importance, such precipita-

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\* Water-Purification; its Biological and Chemical Basis. *Proc. Inst. Civ. Eng.*, vol. lxxxv., p. 197.



tion being conducted, on a large scale, in the process for softening water from limestones, such as the Chalk, by the addition of lime-water, causing deposit of calcic carbonate in a finely divided state. This process, strange to say, has a greater power biologically, in removing organisms, than it has in chemical purification.

The questions as to what harm micro-organisms may do in water—whether some are bad, some good, and some indifferent, and which are which—cannot be here discussed. They belong to another Section. One of our members, however, claims to have taken over 23 millions of them in 18 months, I believe with no evil result; but then he took them in hot water, which, perhaps, they may have relished less than he did, and it is not stated whether he took the water without accompaniment.

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It occurs to me that this may be a fitting occasion to advance a plea for a certain set of scientific men: I mean those who often have to apply their science to practical purposes. Surely those who do their best to apply science to the public good are entitled to some credit, and should not be slighted, as there is sometimes a tendency for them to be, by those who, from various reasons, are enabled to follow the purely scientific bent of their own minds, to give up their time to the delightful pursuit of knowledge in the abstract, and, as it is often put, to study science for its own sake, which perhaps sometimes means that a man does what is pleasant to himself without particular thought of anybody else! Some applyings of science, on the other hand, are hardly likely to be to any one's taste, and, at all events, the ways of sanitary science do not always lead to pleasant places.

Again, I would ask—What is the use of knowledge? Is it merely to be looked on as educational—as improving the mind? Is not the body to be thought of? And is the proverb, *mens sanâ in corpore sano*, to hold only for the individual? Does it not apply to the body politic?

Great researches and discoveries are beyond the power of many of us—of nearly all of us. We cannot all start and establish great theories, largely affecting the progress of science; but we can all do some little to advance knowledge, and with careful observations of facts, followed by fair inferences drawn from those facts, we may help the generalizers of the future. We cannot all be Newtons or Darwins; but we can all do something for the good of our fellow-creatures.

Ald. ROWNTREE (York) moved a vote of thanks to the President of the Section for his address. The President had concluded by saying that we could not all be Newtons or Darwins, but he had shown that he had one point of similarity with Newton, and that was the great modesty that characterised his opening remarks, reminding one of Newton's observation of how comparatively little he knew. But as they had listened they had heard sufficient to show that the President knew a great deal, and a great deal which would be valuable to them all. They were all concerned in the purity of the water supply of their different localities. The citizens of York were interested in it. The history of their water supply was an interesting one, dating back two centuries ago, when it was drawn from the river and distributed in the city in wooden pipes—trunks of trees—which were still occasionally dug up in the streets. Writers on the health of the city last century had spoken of the distribution of the unfiltered water, and particularly when taken during a flood, of its thick nature, as one of the causes which injured the health of the city. The gradual improvement in the supply, the extension of the waterworks, the taking of the water from a greater distance, and then the application of filtering, had all acted beneficially on the health of the city.

Mr. S. W. NORTH (York) seconded the vote of thanks, which was carried by acclamation, and acknowledged by the President of the Section.

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On "*Open Spaces and Physical Education*," by LORD BRABAZON.

### "CIVIUM VIRES CIVITATIS VIS."

OF late years a marked increase has taken place in the number of Urban Parks, Gardens, and Playgrounds of the United Kingdom which are accessible to the public. This activity on the part of municipal authorities and of philanthropic Societies and individuals, is largely owing to the growth of a public opinion favourable to the creation of pleasant oases, refreshing to the mind and body, wherever the undue extension of bricks and mortar has banished man from the humanizing influences of nature, and has turned the soil into a stony wilderness. The credit of giving the impulse which set this public opinion in motion is due in a great measure to Miss Octavia Hill. She it was who in season and out of season was never weary of preaching, often to deaf ears, the importance of open spaces for the benefit of the poor, and especially of their children. She it was who first put into practice the principles she preached,