

plates from keel to gunwale,  $\frac{3}{8}$  to  $\frac{1}{2}$  inch thick; four bulkheads. Diameter of rivets  $\frac{5}{8}$  and  $\frac{3}{4}$ . Distance apart, 2 inches; single riveted. Depth of keel, 5 ins. Dimensions of ditto U  $\frac{1}{2}$  inch plate. One independent steam, fire, and bilge pump. Flanch iron clamped around the gunwale 24 ins. in width by  $\frac{1}{2}$  inch thick, with knees to each frame. Keelsons, 12; fore and aft, 20 inches high. Date of trial Jan. 1859.

C. H. H.

*The Drinking Waters of the Metropolis.\** By EDWIN LANKESTER, M.D., F.R.S., M.R.I.

[Abridged from a paper read at the Royal Institution.]

The water used in London for drinking purposes is obtained from both rivers and springs. The Thames and the New River, and partially other rivers, supply the river water. The spring water is of two kinds. First, from surface wells, obtained by digging through the gravel which covers the London clay in the western parts of the metropolis, and into the clay itself. Secondly, from deep wells, which generally pass through the London clay and penetrate the chalk below. The surface wells receive the soakage of the water which falls over London, and the water is contaminated by the contents of cesspools, drains, and sewers. The deep wells receive their supply of water from the chalk which forms the sides of the great "London Basin." All these waters contain more or less of the following mineral constituents:—

1. *Carbonate of Lime*, of which 3 to 17 grains are contained in the gallon. The carbonate of lime is the most common source of the *hardness* of the waters of London. It may be got rid of by Clark's process, which consists in adding lime to the water. This process would greatly improve the Thames water. This plan is carried out most successfully on a large scale at Plumstead. It was recommended by the government Commissioners, on account of its "health, comfort, and economy."

2. *Sulphate of Lime*, in the proportion of from 1 to 15 grains in the gallon. It decomposes in contact with organic matters, and produces sulphureted hydrogen. Very small quantities of organic matter serve to produce this effect.

3. *Chloride of Sodium* exists in Thames water, from 1 to 4 grains in the gallon; in deep wells, from 10 to 17 grains; and in surface wells, from 20 to 40 grains. In the Thames it may be the produce of the tide; in the deep wells it is washed out of the chalk; but in the surface wells, where it is most abundant, it is derived from the animal and vegetable refuse of the houses through which it percolates. The analyses of above one hundred of these wells showed that they were all equally open to suspicion on this point.

4. *Phosphates and Silica* exist in all the London waters in small quantities.

5. *Ammonia* also has been detected in small quantities in the Thames;

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in much larger and more appreciable quantities in the surface wells. This substance is the result of the decomposition of animal matter, and in the surface wells is undoubtedly derived from human excretions.

6. *Nitrates* result from the oxidation of the ammonia. They are absent in deep wells, exist only in very small quantities in the Thames, but in large and sometimes even dangerous quantities in surface wells. In one water, examined by Mr. Noad, above 50 grains in the gallon were detected.

The *organic* matters are not injurious when fresh or recent, but they assume certain conditions of decomposition which occasionally render them deadly. Their influence may be estimated by the case of the Lambeth and Vauxhall Water Company's supply, during the years 1848 and 1854,—two years in which cholera visited London. In 1848, both companies derived their supply of water from the Thames at Battersea, and both supplied the same district with water, and the houses supplied were equally visited with cholera.

But in 1854, the Lambeth Company obtained an improved supply high up the Thames, at Ditton. The consequence was, according to Dr. Snow's calculations, that the deaths amongst the population supplied by the Vauxhall Company, as compared with the Lambeth, was as 7 to 1; according to the most favorable view of the case, as given by Mr. Swain, it was  $3\frac{1}{2}$  to 1. There is nothing to account for this difference but the larger quantity of organic impurity in the water supplied by the Vauxhall Company, which still obtains water from the more impure source. The outbreak of cholera in the Golden-square district in September, 1854, was traced to the pump in Broad street, which was subsequently found to have communicated with the drain of a neighboring house.

It appears, also, that water containing organic matter acts on lead, and thus adds another source of poisoning to its own. This had been pointed out by Mr. Noad and Dr. Medlock. Organic matters in standing water undergo a kind of fermentation, by which carbonic acid, sulphureted hydrogen, and other gases are got rid of, and nitric acid is formed. The water thus undergoes a process of self-purification. This occurred in Thames water, and accounts for the fact that ships were often supplied with water from the Thames below London Bridge. This water is dangerous to drink before or during the fermenting process.

The appreciation of small quantities of organic matters by chemical processes is a difficult process. During the evaporation of water, the organic matters are dissipated, and not all left in the evaporating basin.

The microscope is an important aid. It detects the nature of organic impurities. These consist of *dead* and *living* animal and vegetable matters. The dead consist of the tissues of animals and plants. The source of these impurities can in some instances be made manifest. Such impurities are very manifest in the Thames and surface-well waters, scarcely to be detected in the deep-well waters. The living matters consist of plants and animals. The filaments of microscopic *Fungi* have been found in impure well water. They have been detected

in several waters known to have been productive of disease. The lecturer had recorded two instances (*Quarterly Journal of Microscopical Science*, vol. iv, p. 270), and others had been published.

Amongst the living animals, the forms of *Infusoria* are most abundant. These are frequently indicative of the impure condition of water. Eggs of the higher animals are not unfrequently found in the Thames water; and some of these undoubtedly belong to those forms of *Annulosa* which find their highest development in the human body.

Many of these forms of animal and vegetable life are not injurious in themselves; but they are most numerous where there is the greatest amount of impurity, and are a measure of the greater or less objectionable nature of a water for drinking purposes. They are not present in water freshly drawn from deep wells.

From these circumstances it is concluded that the water from deep wells is most desirable and unobjectionable as drinking water; *that the water from surface wells ought under no circumstances to be drunk at all*; and that, if Thames water is used, it ought to be filtered, or, what is better, *boiled and filtered*. Boiling expels the carbonic acid from water, and renders it rapid; but its briskness may be restored by passing it through the gazogene. In the filtration of water various agents may be used, as sand, sponge, charcoal, rock, &c. The most effectual is animal charcoal, which may be introduced into any of the ordinary forms of filter. Dr. Medlock has shown that the addition of iron to water containing organic impurities precipitates them without rendering the water metallic. Water which had been filtered in contact with iron twelve months since is still quite pure, while water which has not been thus filtered shows a large quantity of impure vegetable growth.

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#### *Hearder's Patent Telegraph Cables.\**

The invention consists of an improved mode of insulating telegraphic wires for submarine purposes, so as to lessen the inductive action usually known as a statical charge of the surfaces of the insulating sheath or covering, after the manner of a Leyden jar, which action now interferes with the operation of the simple dynamic electric current. He effects this in the following manner:—First, he covers the conductor with cotton, silk, wool, hair, flax, or other fibrous or porous substance or substances, in any of their forms, in one or more layers, previously to coating it with the insulating material, which material may be india rubber, gutta percha, or any of their compounds, or any other insulating composition; or, secondly, he coats the wire with the insulating material, and then applies any of the before-mentioned porous or fibrous substances over the insulating coat, and covers the whole again with the insulating material, and, if necessary, puts on additional alternate layers of fibrous and insulating material; or, thirdly, coats the conductor with the fibrous, porous, or textile materials in the manner described in the first process, and then applies the alternations of insulating and fibrous materials in the manner described in the second process.

\* From the London Mechanics' Magazine, September, 1853.