

4. On the Temperature of the Electric Spark. By  
James Dewar, Esq.

(*Abstract.*)

The author begins this paper by calculating the highest hypothetical temperature that could be produced by the chemical combination of the most energetic elements if all the heat evolved could be thrown into the product. This would not exceed  $19,500^{\circ}$  C. in the case of silica, and  $15,000^{\circ}$  C. in the oxides of aluminum and magnesium, and these are the highest results. The estimation of the temperature of the electric spark is based on the thermal value of each spark, together with the volume of the same. The methods of observing these quantities are fully detailed in the memoir. The general result may be stated thus,—the temperature of the electric spark used in the experiments ranged between  $10,000^{\circ}$  C. and  $15,000^{\circ}$  C.

The following Gentlemen were admitted Fellows of the Society:—

JAMES THOMSON BOTTOMLEY.

THOMAS KNOX, Esq.

Dr D. ARGYLL ROBERTSON.

*Monday, 15th April 1872.*

PROFESSOR KELLAND, Vice-President, in the Chair.

The following Communications were read:—

1. On the Action of Water on Lead. By Sir Robert  
Christison, Bart.

After summarising the conclusions at which he had arrived from numerous experiments made more than forty years ago, as published in his *Treatise on Poisons*, and in the *Transactions of this Society*, the author alluded to various blanks left at that time in the inquiry which had not been yet filled up, and to various criticisms and doubts which had been recently expressed relative to the facts and principles formerly announced.

The general results of the former inquiries are—1. That the purest waters act the most powerfully on lead, corroding it, and forming a carbonate of peculiar and uniform composition; 2. That all salts impede this action, and many prevent it altogether, some of them in extremely minute proportion; and 3. That the proportion of each salt required to prevent action is nearly in the inverse ratio of the insolubility of the compound which its acid forms with the oxide of lead. The effect of certain inorganic and organic ingredients of water in modifying the preservative power of the salts was not investigated, but has been since made the subject of numerous observations and inquiries by others, chiefly, however, of a desultory nature, some of them much too succinctly described, and some also of questionable accuracy.

The first part of the present paper dealt with the influence of inorganic substances. The second part, on the influence of organic matters, was reserved for a subsequent article.

It had been denied that water acts by reason, and in the ratio, of its purity; and it had even been alleged that distilled water itself does not act, if really quite pure. The author, however, had invariably found the reverse, and could assign no other explanation of these statements except some error in manipulation. For example, a very pure spring water was sent to him from the south of England, with the assurance that it had been found to be incapable of attaching lead. But, on making trial of it, he had found it act with an energy not inferior to that of distilled water. Also, it had been stated that ordinary distilled water is apt to contain a trace of nitric or nitrous acid, from nitrates incidentally present in the water subjected to distillation; and that such water, if distilled after the addition of a little potash to fix the acid thoroughly, yields a distillate which has no action on lead. But when the author prepared distilled water in this way, with great care to prevent the access of impurities from other sources, the only result was that the action was even greater than that of the ordinary distilled water of the laboratory, and so great as he had never observed before.

An interesting statement had been made by Dr Nevins, that some salts appear to allow of a certain action going on when they are present largely in water, although their influence, when they

exist in very small proportion, is to act as preventives. The author sometimes obtained the same result, and found the action such as might prove dangerous. But its limit requires to be defined; and there is reason to suppose that the proportion required to permit action will be found so great as never occurs in the instance of waters applicable to household use.

It has been also stated, but in general terms, without experimental proof, that the presence of carbonate of soda, even in a hard water, takes away the preventive influence of other salts, and enables water to dissolve lead. There appears to be some foundation for this statement. But here, too, it is necessary to fix what is the limit to such influence before its importance can be valued. Moreover, as bicarbonate of soda appeared to the author to have no such effect, and this is the usual form of the carbonate in natural waters, the practical importance of the fact is inconsiderable.

The author called attention to some observers not having understood the nature of the corrosive action of water on lead, and having confounded it with other causes of corrosion. Thus the true action has been confounded with the corrosive action of potent agents accidentally coming in contact with the metal in presence of water, —as, for example, when a lead pipe has been led through fresh mortar which is frequently or permanently kept moist, or when lumps of fresh mortar have been allowed to fall upon the bottom of a lead cistern. Several remarkable examples of rapid corrosion of this local kind were exhibited. The true or simple action of water had been not infrequently confounded also with the effects of galvanic action. Thus, if a lead pipe or cistern be soldered with pewter-solder, and not with lead, erosion takes place near the line of junction of the solder with the lead, of which characteristic examples were shown. The presence of bars of other metals crossing lead, or bits of them lying on it, will also develop the same action; and some facts seem to point to the same property being possessed in a minor degree by some stony and earthy substances. This observation may explain the local erosion sometime observed in cisterns containing hard water; since, if galvanic action be excited, it will be increased by saline matter existing more largely in these waters than in soft, or comparatively pure, water.

Lastly, some observers have contradicted former statements,

because in certain circumstances, which led them to anticipate no action, they nevertheless found lead in water, but only in extremely minute and unimportant proportion. The test for lead, the hydrosulphuric acid, when employed in the way now usually practised, is so delicate as to detect that metal dissolved in ten million parts of water, and even more. But facts warrant the conclusion that the impregnation must amount to at least ten times as much before water can act injuriously on man, however long it may be used.

## 2. On the Preservation of Iron Ships. By James Young, Esq., of Kellie.

My attention was called in January last year to the rusting of iron vessels by observing that the bilge water of my yacht (the "Myanza," 214 tons) was much discoloured by red oxide. Knowing that bilge water is apt to become acid, and thus to attack iron, the result was easily accounted for. Even when the water does not become acid, we may expect some action on the iron to take place when sulphuretted hydrogen exists, as it frequently does there, in which case, first a sulphide, then an oxide, and some sulphate, are formed. The remedy seemed to be easy, because the acid can be neutralised by lime. This earth would also prevent the formation of sulphuretted hydrogen.

I put this immediately into practice, adding lime until the bilge water was alkaline; and samples were taken every fourteen days, which showed the amount of rust to be rapidly diminishing. After six months the liquid became perfectly clear, so that the cure is complete. The yacht is a composite one, and the action is therefore greater than in iron vessels generally, because of the copper or cupreous bolts which are used. These bolts cause galvanic currents with the iron, and greatly assist in its oxidation and solution.

As a very little lime will last a long period, the plan causes neither trouble nor expense. Seeing in the newspapers that the destruction of the "Mægara" was attributed to the action of bilge water, I thought that my experience might be of some value.