

## PLUMBER'S WORK.\*

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I propose to divide the subject into the following sections—the historical, chemical, and practical. As it is almost impossible to separate the material from the labour, I will refer first to the metal from which the trade of plumber derives its name. Lead is one of the most widely diffused and most important metals we possess. It is mentioned as common in the time of the Exodus—for Moses, in his song of triumph at the destruction of Pharaoh's chariots and horses in the Red Sea, uses the time-honoured metaphor familiar to all ancient poets—"They sank as lead in the mighty waters." We have other proofs of its common application among the Hebrews. It was among the spoils taken from the Midianites, and the articles made from it were ordered to be melted up. But one of its most singular applications was that alluded to by Job—"Oh, that my words were now written; Oh, that they were printed in a book; That they were graven with an iron pen and lead in the rock for ever." No trace of ancient lead mines has been found within the boundaries of Palestine, and hence it is probable the Israelites obtained their supply through the Phœnicians. The Phœnicians we know imported tin and lead from Britain, and both are enumerated in the graphic account of the commerce of Tyre in the 27th chapter of Ezekiel. It is a very curious question whether the plumber, properly so called, was first acquainted with his business as regards covering roofs with sheets of lead, or as regards the conveyance of water through lead pipes. Some writers think that it was on roof work the trade took its origin, the art of casting lead into sheets being of immense antiquity. The terraces of Nebuchadnezzar's hanging gardens were covered with sheets of lead soldered together to retain the moisture in the soil. Leaden pipes it is believed are as old as the dawn of history. Archimedes used pipes to distribute water by engines on the large ship built for "Hiero," and the same kind were doubtless common among the Babylonians, the Persians, and the Egyptians, whose hydraulic machines were complete in their construction before the civilization of Greece or Rome. The limits of this paper will not permit reference to plumber's work as connected with ancient fountains. It may be remarked that an ancient stop cock discovered in the ruins of a temple at Capri is still preserved in the Museum at Naples. It differs from the common stop-cock at present in use, by having what is technically termed a "round water way," or a water way equal in sectional area to the tube, which the ordinary stop-cocks do not possess.

With regard to the invention of soldering it is exceedingly difficult to determine the exact position in which it is to be placed in ancient history. It is certain the Greeks and Romans used something answering the purpose of joining metals in this position, and Pliny speaks of a solder which he denominates *plumbum argentarium*, and which would seem to have something of the same composition as our common plumber's solder. On the other hand, the method of fastening metals together by means of rivets was far more commonly in use, and indeed we are not sure whether it was not the only method known to the Greeks in their best days. It is known for certain they were utterly unacquainted with the art of welding iron, and it seems highly probable they were also ignorant of the art of soldering lead, which involves a much higher and more extended knowledge of metallurgy. An illustration of the Roman plumber work of the aqueducts can be given in proof of this. In rounding a hill, they sometimes used lead; but it does not appear that the plumbers could make a curve, or even construct an acute angle on their pipe. Where such bendings were necessary an elbow was bored in a solid piece of stone into which the two ends of the pieces of pipe were cemented. It appears that when the Romans wished for perfectly pure water (of course not chemically pure) they employed two cisterns at different levels for the purpose of allowing the sediment to deposit in the one before it was drawn into the other.

To proceed to a rapid glance at the early history of plumber's work in this country, particularly with respect to its application to the churches of the middle ages. The churches and castles of Europe during the middle ages were almost uniformly covered with lead. The Saxons in the earlier periods of their

history covered their buildings with slate, but their most magnificent structures were overlaid with lead. In the time of King Edgar, the buildings added to the Monastery of Croyland were according to Ingulphus strongly built and covered with lead; and in a statute passed in the fourth year of the reign of King Edward I. (A.D. 1276) to ascertain the value of real estates commissioners were appointed to "visit castles and other buildings compassed about with ditches, to determine what the walls, buildings, timber, stone, with lead, and other manner of covering, is worth." I must not, at present, say anything about the method of laying the lead, as the practical portion of my subject will be treated on hereafter. One very remarkable point of the plumber's business during the middle ages was the construction of the organ pipes in the churches. The practice was common even down to the foundation of St. Paul's Cathedral, for the fire which occurred there during the progress of the works was attributed to the plumbers who were repairing the organ pipes. Leaden coffins were very common in England, particularly after the Crusades. Geoffrey Mandeville, who died during the reign of Henry I., under the curse of excommunication, could not be buried in consecrated earth. "Therefore," says Camden "some of the Knights Templars enclosed him in a pipe of lead, and hung him upon a tree in an orchard at the old Temple." Edward the Black Prince being dead, "his body," says Froissart, "was embalmed, and put in a vessell of lead." And the corpse of his successor, we are told by Harding, was "lapped in lede," and so from that time thenceforward were the mortal remains of the Kings of England.

The next is the chemical division of the subject:—The principal ore of lead is the sulphurets, which generally contains silver as well as lead in combination with sulphur. After the ore has been taken from its bed it is smelted, first being picked, in order to separate the rich or genuine ore from the strong matrix and other impurities; the picked ore is then pounded under stampers actuated by machinery, and afterwards washed to carry off the remainder of the matrix that could not be separated in picking. It is next put into a reverberatory furnace to be roasted, as it is termed, during which operation it is repeatedly stirred to facilitate the evaporation of the sulphur. When the surface begins to assume the appearance of a paste, it is covered with charcoal and well shaken together, the fire is then increased, and the purified lead flows down on all sides into the basin of the furnace, whence it is run off into moulds prepared for its reception. The moulds are capable of receiving 154 pounds of lead each, and their contents, when cool, are called "pigs." The natural colour of lead is a bluish white when newly melted or cut; it is very bright; its specific gravity is 11.45, and it melts at 600° F. Lead, I need not tell you, is used in immense quantities in the shape of pipes and sheets; the former for conveying, and the latter in storing water. We will now proceed to consider what effect, if any, water has on this metal. It is now nearly twenty years since a number of letters, &c., appeared in the pages of the *Builder* on this interesting and important subject. Having carefully read those letters, I think I cannot do better than give some extracts from an article as published in Vol. X. of the *Builder*, under the heading of "A Grave Question in which Doctors Differ." In this article all important evidence is carefully placed before the reader, and he can perhaps form his own judgment as to the safety of storing water in lead cisterns, or in using lead pipes as a means for its conveyance. In the article before referred to it is stated that in 1829 Professor Christison first published an extended account of his investigations into the whole subject of the action of different waters on lead. Other authorities followed, but although Christison has since more than once recurred to the question, and drawn pointed attention to its practical importance and its details, we find even recent writers of note still passing it over with little or no attention. Thus, in 1843, Professor Orfila treats of it in a few lines only, and even these, as Christison alleges, contain several inaccurate statements. Still more recently we have searched in vain for even a single hint or allusion, either in text or note, in "Turner's Chemistry," edited by Liebig. Graham appears to say nothing about it. Brande does not recognise its importance, as we shall afterwards see, but he not only coincides with Christison in the main, but refers his readers to him for "a good epitome of all that relates to the action of water on lead." Of the mutual influence of soft water and lead, then, Professor Christison, in his "Treatise on Poisons" (ed. 1845, p. 517) says:—"Distilled water, deprived of its gases by ebullition, and excluded from con-

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