SCIENCE IN ANTIQUITY.

MIRACULOUS VESSELS.

Ctesias, the Greek, who was physician to the Court of Persia at the beginning of the fourth century of our era, and who has written a history of that country, narrates the following fact: Xerxes, having caused the tomb of Belus to be opened, found the body of the Assyrian monarch in a glass coffin which was nearly full of oil. "Woe to him," said an inscription at the side, "who, having violated this tomb, does not at once finish the filling of the coffin."

Xerxes, therefore, at once gave orders to have oil poured into it; but whatever the quantity was that was put in, the coffin could not be filled. This miracle must have been effected by means of a siphon, analogous to the one found in the Tantalus cup, and which becomes primed as soon as the level rises in the vessel above the horizontal; that is, on a line with the upper part of the tube's curve. In fact, proof has been found of the use of the siphon among the Egyptians as far back as the eighteenth dynasty, and Heron, in his *Pneumatics* (book xii., chapt. iii.), describes a very large number of vessels that are founded upon its use.

The ancients, likewise, solved a problem contrary to that of the tomb of Belus, and that was one connected with the construction of a vessel that should always remain full, whatever was the quantity of water that was removed from it; or, at least, which should remain full even when a large quantity of water was taken from it.

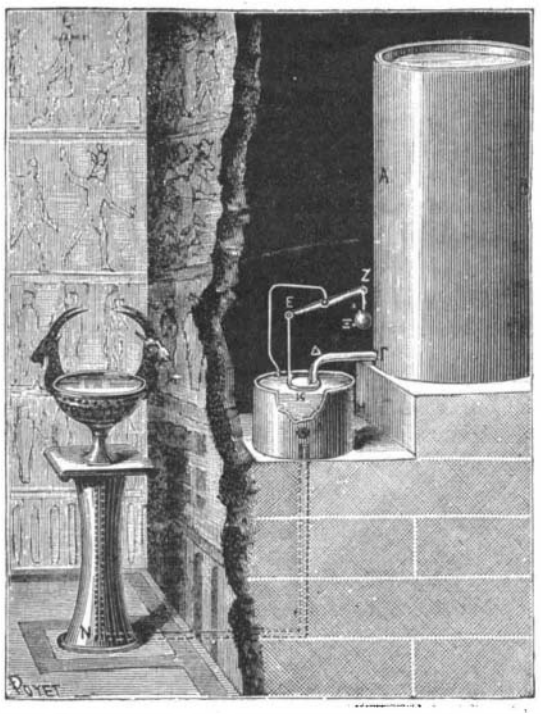

Fig. 1.—A MIRACULOUS VESSEL OF HERON.

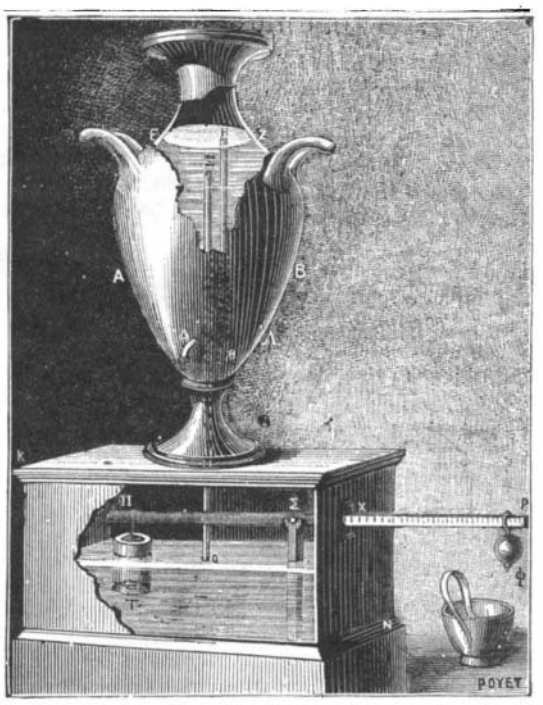

Fig. 2.—MIRACULOUS VESSEL OF HERON.

The annexed engraving (Fig. 1) shows one of the arrangements employed.

"Let *A B* be a vessel containing a quantity of water equal to that which may be demanded, and *Γ Δ* a tube that puts it in communication with a reservior, *HΘ*, lower down. Near this tube there is fixed a lever, *E Z*, from whose extremity, *E*, is suspended a cork float, *K*, and to whose other extremity, *Z*, there is hooked a chain that carries a leaden weight, *Ξ*.

"The whole should be so arranged that the cork, *K*, which floats on the water, shall close the tube's orifice, that when the water flows out the cork, in falling, shall leave such aperture free; and, finally, that, when a new supply of water enters, the cork shall rise with it and close the orifice anew. To effect this the cork must be heavier than the leaden-weight suspended at *Ξ*. Now, let *Δ M* be a vessel whose edges should be at the same height as the level of the water in the reservoir when there is no flow through the tube because of the cork float. Again, let *Θ N* be a tube that connects the reservoir with the base of the vessel, *Δ M*.

"So, then, when we remove water from the vessel, *Δ M*, after it has once been filled, we shall at the same time lower the level of the water in the reservoir, and the cork, in falling, will open the tube. The water thereupon running into the lower reservoir, and from thence into the external vessel, will cause the cork to rise and the flow to cease, and this will occur every time that we remove water from the tazza." There were, also, vessels which discharged but a certain definite quantity of the liquid that they contained. We have already described one of these, but here is another that is more complicated, wherein the quantity of liquid that it measures out may be caused to vary in the same vessel.

A vessel containing wine, and provided with a spout, being placed upon a pedestal, to cause the spout, by the simple moving of a weight, to allow a given quantity of wine to flow; now, for example, half a cotyle (0·13 *liter*), *and now a whole cotyle; or, briefly, any quantity that may be desired.*

"Let *A B* be the vessel into which the wine is to be put (Fig. 2). Near its bottom there is a spout, *Δ*. Its neck is closed by a partition, *E Z*, through which passes a tube that runs to the bottom, but leaving, however, sufficient space for the passage of the water. Let *K Δ M N* be the pedestal upon which the vessel stands, and *Ξ O* another tube that reaches as far as to the partition and enters the pedestal. In the latter there is sufficient water to stop up the orifice of the tube, *Ξ O*. Finally, let *Π P* be a lever, half of which is in the interior of the pedestal and the other half external to it, and which pivots on the point *Σ* and carries suspended from its extremity, *Π*, a clepsydra having an aperture, *T*, in the bottom.

"The spout being closed, the vessel is filled through the tube, *HΘ*, before putting water into the pedestal, so that the air may escape through the tube, *Ξ O*. Then through any aperture whatever, water is poured into the pedestal in such a way as to close the orifice, *O*; and, after this, the spout, *Δ*, is opened. It is clear that the wine will not flow, since the air cannot enter anywhere. But, if we depress the extremity, *P*, of the lever, a part of the clepsydra will rise from the water, and the orifice, *O*, being freed, the spout will flow until the water lifted up in the clepsydra has, on running out, closed this same orifice again. If, when the clepsydra has become full again, we still further depress the extremity, *P*, the liquid in the clepsydra will take longer to flow out, and more wine will consequently be discharged from the spout. If the clepsydra rises entirely from out the water, the flow will last still longer yet. Instead of depressing the extremity, *P*, by hand, we may use a weight, *Φ*, which is movable on the external part of the lever and capable of lifting the whole of the clepsydra out of water when it is placed near *P*. This weight, then, will lift a portion only when it is farther away from such point. We must proceed, therefore, with a certain number of experiments upon the flow through the spout, and make notches on the lever arm, *P X*, and register the quantities of wine that correspond thereto, so that, when we desire to cause a definite quantity to flow, we shall only have to put the weight on the corresponding notch and leave it."

Fig. 3.—HERON'S DRINKING HORN.

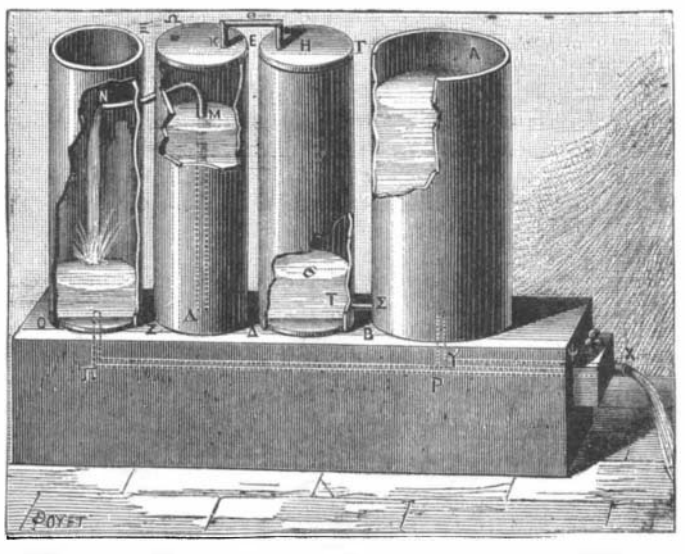

Fig. 4.—AN APPARATUS OF HERON PERMITTING OF MIXING WINE AND WATER IN DEFINITE PROPORTIONS.

WATER CHANGED INTO WINE.

The miracle of changing water into wine is one of those upon which the ancients exercised their imaginations most. Heron and Philo describe fifteen apparatus designed for effecting this, and more generally for causing different liquors to flow at will from the same vessel.

Here is one of the simplest of them (Fig. 3): "There are," says Heron, "certain drinking horns which, after wine has been put into them, allow of the flow, when water is introduced into them, now of pure wine, and now of pure water.

"They are constructed as follows: Let *Δ B Γ Δ* be a drinking horn provided with two diaphragms, *Δ E* and *Z H*, through which passes a tube, *Θ K*, this being soldered to them and containing an aperture, *Δ*, slightly above the diaphragm, *Z H*. Beneath the diaphragm, *Δ E*, there is a vent, *M*, in the side of the vessel.

"Such arrangements having been made, if any one, on stopping the orifice, *Γ*, pours wine into the horn, the liquor will flow through the aperture, *Δ*, into the compartment, *Δ E Z H*, since the air contained therein can escape through the vent, *M*. If, now, we close the vent, the wine in the compartment, *Δ E Z H*, will be held there. Consequently, if, on closing the vent, *M*, we pour water into the part, *ABΔE*, of the vessel, pure water will flow out through the orifice, *Γ*; and if, afterward, we open the vent, *M*, while there is yet water above the upper diaphragm, a mixture of wine and water will flow out. Then, when all the water has been discharged, pure wine will flow.*

"On opening and closing the vent, *M*, oftener, the nature of the flow may be made to vary; or, what is better still, we may begin by filling the compartment, *Δ E Z H*, with water, and then, closing *M*, pour out the wine from above. Then we shall see a successive flow of pure wine and of wine and water mixed when we open the vent, *M*, and then, again, of pure wine when the vent is closed anew; and this will occur as many times as we desire it."

The apparatus represented in Fig. 4 is very curious, and might be put to some useful application, without mentioning that which wine merchants might make of it by changing the order of the liquids and leaving in view only the vessel, *A B*, and the cock.

"Being given," says Heron again, "two vessels, one of them containing wine, it is required that whatever be the quantity of water poured into the empty one, the same quantity of a mixture of wine and water, in any proportion whatever (two parts of water to one of wine, for example), shall flow out through a pipe.

"Let *A B* be a vessel in the form of a cylinder, or of a rectangular parallelopipedon. At the side of it, and upon the same base, we place another vessel, *ΓΔ*, which is hermetically closed, and of cylindrical or parallelopipedal form, like *A B*. But the base of *A B* must be double that of *Γ Δ* if we desire that the quantity of water shall be double that of the wine in the mixture. Near *Γ Δ* we place another vessel, *E Z*, which is likewise closed, and into which we have poured wine. The vessels, *Γ Δ* and *E Z*, are connected by a tube, *H Θ K*, which traverses the diaphragms that close them at their upper part, and which is soldered to these. In the vessel, *E Z*, we place a bent siphon, *Δ M N*, whose inner leg should come so near to the bottom of the vessel as to leave just enough space for the liquid to pass, while the other leg runs into a neighboring vessel, *Ξ O*. From this latter there starts a tube, *Π P*, which passes through all the vessels, or the pedestal that supports them, in such a way that it can be easily carried under and very near the bottom of the vessel, *A B*. Another tube, *Σ T*, traverses the partitions in the vessels, *A B* and *Γ Δ*. Finally, near the bottom of *A B* we adjust a small tube, *Υ*, which we inclose, with the tube *H Γ*, in a pipe, *Φ X*, that is provided with a key for opening or closing it at will. Into the vessel, *E Z*, we pour wine through an aperture, *Ω*, which we close after the liquor has been introduced.

"These arrangements having been made, we close the pipe, *X Φ*, and pour water into the vessel, *A B*. A portion, that is to say one-half, will pass into the vessel, *Γ Δ*, through the tube, *Σ T*, and the water that enters *Γ Δ* will drive therefrom a quantity of air equal to itself into *E Z* through the tube, *H Θ K*. In the same way this air will drive an equal quantity of wine into the vessel, *O Ξ*, through the siphon, *Δ M N*. Now, upon opening the pipe, *Φ X*, the water poured into the vessel, *A B*, and the wine issuing from the vessel, *O Ξ*, through the tube, *Π P*, will flow together, and this is just what it was proposed to effect."—*A. De Rochas, in La Nature.*

A TABLESPOONFUL of turpentine boiled with white clothes will greatly aid the whitening process.

* As may be seen, this is, under another form, the apparatus known in cabinets of physics as the "Magic Funnel."