led to the general conclusion, that “ when solutions of primary combinations of elementary bodies in water, and in those liquids, such as alcohol and pyroxylic spirit, which contain water as such as an essential constituent, are sub­mitted to voltaic agency, the dissolved substance is not directly decomposed by the current, but only the water of the solvent.” The rule of course does not include solu­tions of combinations of the second order, such as ordinary salts, consisting of an acid and an alkali, but those of prim­ary compounds of elementary bodies, such as acids, alka- lies, &C.@@1

When absolute alcohol, holding a minute quantity of pure caustic potash in solution, such as 1/500, is subjected to moderate voltaic agency, hydrogen gas is evolved from the negative pole, and no elastic fluid from the positive ; and if a powerful battery, such as 200 pairs of four-inch plates, is employed, the same effect is obtained with ab­solute alcohol holding nothing in solution. A long inves­tigation showed that this result is due to the direct voltaic decomposition of the water entering into the constitution of absolute alcohol; its hydrogen being evolved at the ne­gative pole, and its oxygen being engaged in producing various secondary changes on the hydro-carbon of the alcohol. The effect of the potash is merely to give con­ducting power to the alcohol, and to favour the secondary action by its affinity for some of the secondary products. The addition of a minute quantity of potassium answers better than that of the hydrate of potass, because we thus, by the oxidation of the potassium, in effect add anhydrous potass, and avoid any addition of water, although in reality the water of the hydrate has no influence whatever on the result. Even 1/10000 of potass has a very decided effect in promoting the voltaic agency, and various other saline bodies when dissolved promote the action by increasing the conducting power. These experiments. It is conceived, prove *directly* what had previously been very generally *in­ferred,* that water as such enters into the constitution of ab­solute alcohol. A similar conclusion was drawn from similar experiments on the analogous substance, pyroxylic spirit.

It was found that pure rectified ether showed no symp­tom whatever of decomposition, when acted on by 200 pairs of four-inch plates ; nor did the previous solution in it of as much caustic potass as it could take up, lead to any action of the voltaic current. It was therefore con­cluded that ether is not a hydrate.@@’

Sect. IX.— *On the Application of Voltaic Electricity to the Arts.*

There is perhaps no science, not even excepting che­mistry, which has made such donations to the fine and use­ful arts as voltaic electricity. Those which depend on gal­vanism are the art of protecting the copper sheathing of ships ; the galvano-plastic art, or that of multiplying works of art in metals, electro-metallurgy, and the reduction of the metals, the electrotype, or the art of copying and mul­tiplying engravings, and galvanic etchings.

1. *Protection of copper Sheathing.* This art, invent­ed by Sir H. Davy, has been already sufficiently described in our article, Davy, vol. 7, p. 662.

2. *The Art of Multiplying Works of Art in Metal.* This beautiful art seems to have been invented about the same time by Mr Jacobi of St Petersburg, and Mr Spencer of Liverpool. Mr Jacobi, who announced his discovery in October 1831, called it the galvano-plastic process, and Mr Spencer had, previous to the knowledge of Mr Jacobis' la­bours, executed medals in copper, which were called elec­trotypes or voltatypes. Both Mr Jacobi and Mr Spencer had confined their invention to the deposition of copper upon metallic bodies ; but Mr Murray announced in Janu­ary 1840, that non-conducting substances, such as *plaster of Paris, wax, wood,* &c*.,* might have metallic copper thrown down upon them by previously *metallising* their surface with black lead.

The single cell apparatus for taking casts of coin and medals is shewn in fig. 47, which consists of an outer vessel A, containing a saturated so­lution of sulphate of copper, and some un­dissolved crystals of the sulphate suspended near the upper surface of the fluid. The medal *m,* to be copied, is suspended in the copper solution. The inner vessel B, made of porous earthenware, contains the usual dilute acid, which acts upon a rod or plate of zinc Z, the upper end of which is con­nected with the bent wire *w* which sus­pends the medal *m*. When the medal has remained two or three hours in the copper solution, the copper will be found to have deposited itself on every part of its surface, so as to afford a perfect intaglio or *hollow* impression of the medal. If the surface of the medal or any part of it is greas­ed, no copper will be deposited on the greased part. The obverse and reverse of the coin or medal being thus copied, and the two retained at their proper distance, the next step is to place them at *m* in the copper solution, and we obtain in the same manner a *raised* impression from the intaglio one, accurately resembling the original.

Instead of obtaining the intaglio cast directly in copper it is thought best to take it either in fusible or type metal, or in some non-conducting substance, such as sealing wax, bees’ wax, rosin, plaster of Paris, stearine, &c. When non­conducting substances are employed, those which are ab­sorbent, such as plaster of Paris, must be prevented from absorbing the fluid, by rubbing the surface of the intaglio mould with tallow or spermaceti ; they are then to be me­tallised by covering their surface with black lead.

When we wish to form gold and silver medals, a gold or silver surface is necessary, as non-conducting bodies are not well fitted for this branch of the art. For a gold medal, a strong nitro-muriatic solution of gold should be used, and the medal to be copied should, according to Mr Smee, be connected with the zinc end of a series of from four to twelve batteries. A very fine platinum wire, ac­cording to the same author, immersed in the solution@@\* to a trifling depth, must be united to the platinised silver of the battery, and the deposit of gold will then take place. For silver medals a solution of the nitrate, sulphate, or acetate, may be used. The solution should be weak at first, and then gradually increased. If we do not wish to have the whole medal of solid gold and silver, a thin layer may be deposited, and the rest completed by copper. On the same principles medals of platinum or palladium may be formed from their solution. Great care must be taken to prevent bubbles of air from forming on the mould.

The difficulty of coining large medals gives great value to this art. Mr Smee mentions a very fine medal of Boulton, about four inches in diameter, which required no less than 300 blows to insure a perfect impression. Seals

@@@1 Transactions of the Royal Society of Edin., vol. xiii., xiv , and xv.

@@@\* Transactione of the Royal Society of Edin, vol. xiii, and xiv., and Lond. and Ed. Jour. Dec. 1841.

@@@3 In Mr Smee's ingenious battery, the negative plate which be makes of platinum or silver is roughened with solid paper; or in the case of silver, with nitric acid, and this roughened surface is covered by galvanic agency, with the finely divided black powder of plati­num for the purpose of increasing the solution of hydrogen For these purpose· platinized silver is now manufactured for sale. See Smee’s *Elements of Electro metallurgy.* Lond. 1841, p. 1718.