XVI. *Actual Fire and Detonation produced by the Contact of* Tin-foil, *with the Salt compoſed of Copper and the Nitrous Acid. By* B. Higgins, *M. D. Communicated by* R. Brockleſby, *M. D. F. R. S. and of the* Royal College *of* Phyſicians *in* London.

Read Dec. 24, 1772, and Jan. 28, 1773.

SEVERAL pieces of thin ſheet-copper, placed vertically, and at a ſmall diſtance from each other, in the ſtrong nitrous acid diluted with half its quantity, or more, of water, and ſuffered to remain in a cloſe veſſel, until the acid is ſaturated, afford a cryſtalline blueiſh green ſalt, which is to be ſeparated from the undiſſolved copper and the ſuperfluent green liquor, and kept in a well-corked bottle; becauſe, on expoſure to the air, it deliqueſces.

This ſalt, taken moiſt, but not very wet, and beaten to the fineneſs of baſket ſea-ſalt, in a mortar, is to be ſtrewed to the thickneſs of a ſhilling, on a piece of tin-foil, twelve inches in length and three in breadth.

Then the foil is to be inſtantly rolled up, ſo as to include the ſalt, as it lay, between the coils. The ends are to be ſhut by pinching them toge-

ther, and the whole is to be preſſed flat and cloſe.

All this being done as quickly as poſſible, the firſt phænomenon is—A part of the ſalt deliqueſces.

2d. This part, impregnated with tin, changed in colour, and of a thicker conſiſtence, begins to froth forth from the ends of the coil.

3d. A ſtrong frothing, accompanied with moderate warmth.

4th. The emiſſion of copious nitrous fumes.

5th. Heat intolerable to the fingers.

6th. Exploſion and fire, which burſt and fuſe the tin-foil in ſeveral places, if it be very thin.

After many conjectures and experiments, I diſcovered a property in the cupreous ſalt, from which, and the known affinities of the bodies concerned, theſe appearances, however new and ſingular, may be accounted for.

The cupreous ſalt properly dried and placed where it may receive a heat, not much greater than what the hand can bear, takes fire. The circumſtances which favour this ignition, and contribute to produce it in the ſmalleſt degree of heat, concur in the following convenient method of trying the experiment.

A piece of ſoft bibulous paper is to be dipped in the nitrous ſolution of copper, and dried before the fire two or three times alternately. Then it is to be approached towards the heat, as near as can be borne, by the hand which holds it without pain: there, if it has been ſufficiently dried, it will preſently catch fire, and burn to a brown calx.

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The eaſy ignition of the ſalt in a ſlight heat being thus aſcertained, there is no room to doubt that the foregoing phænomena are produced in the following manner.

The acid of the liquor, which moiſtened the ſalt, quits the copper to unite with the tin, leaving the water to be imbibed by the contiguous ſalt of copper, which then diſſolves, and acts briſkly on the tin-foil.

It is well known that the action of the nitrous acid on tin is always accompanied with conſiderable heat and efferveſcence, and that the ſolution of metallic ſalts in watry liquors is haſtened by heat.

In our experiment, the warmth generated by the firſt action of the cupreous ſolution, promotes the deliqueſcence of the cryſtallized ſalt. The union of the acid with the tin is rapid, not only as being aſſiſted by heat, but on account of the great ſurface expoſed; whence the ſtrong frothing, and the extraordinary heat, by which the redundant moiſture is carried away, and the undecompoſed part of the cupreous ſalt, together with that lately formed with the tin, perfectly dried.

The heat generated upon both ſurfaces of a large expanſe of tin, is concentrated by cloſely coiling it into a ſmall compaſs, and being retained by the various ſurrounding laminæ of metal, it is neceſſarily accumulated to a quantity, which, if we may judge from the touch, is more than ſufficient to fire the dry cupreous ſalt.

The ſalt formed with tin, and the nitrous acid, burns and ſparkles in a red heat. Catching fire, therefore, from the ignited cupreous ſalt, it burns

with it, and aſſiſts in the detonation, which is common to all nitrous compoſitions in ſimilar circumſtances.

If the ſalt be very wet, there will not be much fire or exploſion, becauſe the heat will be diſſipated before the ſalt can be ſufficiently dried in every part.

If the ſalt be not moiſt, it cannot commence the action which is neceſſary; and there will be no fire, becauſe there can be no haſty ſolution of the tin to give the requiſite heat.

If the tin and ſalt be not coiled up in due time, there will be very little heat and no fire; becauſe the diſſipation of the heat from a broad expanſe, keeps pace with the generation of it; and as the moiſture exhales quickly in this manner, there is none left to renew the action on the tin and conſequent heat, when the proper time of coiling has elapſed.

A piece of tin-foil, larger than that I have deſcribed, cannot eaſily be managed; ſmaller pieces give leſs fire in the direct proportion of their ſurfaces, and the quantity of ſalt which they can, at the ſame inſtant, reduce to the required ſtate of dryneſs.

The ſudden diſſipation of the moiſture appears to me the moſt curious of theſe phænomena. To render it the more obſervable, I made the following experiments.

I placed a piece of tin-foil, twelve inches long by two broad, looſely coiled, and ſtanding vertically on the flatteſt end, in half a table-ſpoonful of the ſaturated ſolution of copper in the diluted nitrous acid, and found that ſcarce five ſeconds elapſed

elapſed from the time, when a briſk efferveſcence, accompanied with weak nitrous fumes, aroſe, until the liquor became a conſiſtent maſs, and ſparks of fire iſſued from the coils of tin; which having attracted part of the ſolution above the common level, brought it into the condition in which it is readily dried, heated, and fired.

A like quantity of the ſame ſolution, kept in a ſtrong boiling heat, does not acquire ſuch conſiſtence in a ten-fold ſpace of time.

The haſty exhalation, therefore, is not cauſed by the heat alone; neither does it ſeem to require any great ſurface. What elſe it is owing to, I commit for a while to the examination of the curious.

Orchard-Street, Portman-Square, Dec. 23, 1772.

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