

VI. *Observations on the Affinities of Substances in Spirit of Wine.*
In a Letter to Richard Kirwan, Esq. F. R. S. by John
Elliot, M. D.

Read January 19, 1786.

S I R,

IN your excellent papers on the attractive powers of the mineral acids, you shew that metallic calces have stronger attractions to those acids, than alkalies and earths. The following experiments not only confirm this doctrine, but also a position that I have lately ventured to advance*, “that certain decompositions will take place in spirit of wine, which will not at all in water, nor in the *dry* way.”

I have shewn, that if expressed oil be mixed with flaked lime into a paste, so as to form calcareous soap, and mild alkali be added, the latter will not decompose the former, either in water or by fusion. But that if spirit of wine be substituted for water, an alkaline soap and mild calcareous earth will be formed. As sea salt contains the fossil alkali, and as by your table of affinities acids have stronger attraction to metallic calces than to alkalies, I concluded, that if sea salt were added to a metallic soap, a similar double decomposition would take place.

* In an Appendix to the second edition of the “Elements of the Branches of Natural Philosophy connected with Medicine.”

To try this I took some diachylum, which had been bought at Apothecaries-Hall, and added to it sea salt; then covered them to a sufficient height with spirit of wine, and set the bottle over the fire. Soon after they had boiled, the decomposition of the diachylum began to be apparent. When the boiling had continued some time, I removed the vessel from the fire, and after it had stood a few minutes, decanted the clear liquor while hot; then evaporating it, obtained a true alkaline soap. The residuum of course contained a quantity of calx of lead, combined with marine acid.

But much of the diachylum remained either wholly or partly undecomposed: I therefore added more sea salt, and spirit of wine, and obtained a further yield of soap. But though much sea salt remained behind, diachylum was still found in the residuum. I found, indeed, that if the ingredients were previously freed from their water, the process succeeded to somewhat better advantage.

From five ounces of diachylum I did not get quite three ounces of soap. This soap was likewise soft, and contained a portion of oil not combined with a sufficient quantity of alkali. The oil, I suppose, had existed in a similar state in the diachylum: and I remarked, that as the spirit evaporated, it gave out the true soap first, the unsaturated oil not till afterwards; so that the latter might easily be obtained separate from the former.

If too much salt was employed, much of it was taken up by the liquid, and communicated to the soap, at least if the ingredients had not been previously deprived of their water. To separate this salt I dissolved the soap in hot water. When the liquor was cold, the soap floated at top, the salt remaining in the water underneath. If too little salt was used, this
inconvenience

inconvenience did not happen, or not in so great a degree, though then less soap was of course obtained.

As diachylum, though with a greater proportion of litharge, and boiled longer than that I had from the Hall, still contained oil not sufficiently saturated, I made the metallic soap in another way. To a solution of sugar of lead in water I added a solution of alkaline soap in the same liquid. A double decomposition took place, the oil uniting with the calx of lead, the alkali with the acid of salt. Using this metallic soap instead of the other, I obtained an alkaline soap harder and more perfect than in the preceding process; but still found that part of the oil remained with the calx of lead in the residuum, and adhered so firmly, that repeated quantities of sea salt and spirit of wine did not wholly separate it.

As I have given this process more with a philosophical view than any other, I have been thus particular in my account of it, to shew that however eligible it may appear at first view, it will not answer for making soap for common sale. The alkali indeed is procured much cheaper than from barilla, as the lead may be revived and re-calcined into litharge. But the whole of the oil or fat cannot easily be converted into soap, though in order the better to effect it, I have mixed sand with the diachylum: and as the oil and litharge must, in the large way, be united by boiling, a considerable part of the former will not be sufficiently saturated. Fuel must be used, not only for forming the metallic soap, but likewise for decomposing that soap, and then distilling off the spirit, which will also require additional time and labour. The quantity of spirit of wine lost, though the process (so far as that liquid is concerned) be performed in a still, will alone nearly counterbalance the saving in respect to alkali. And in the process itself
there.

there is considerable danger, not only of the spirit taking fire from the carelessness of the workmen, but likewise from the frequent explosions that happen during the decomposition of the metallic soap.

As in the experiment with calcareous earth and mild alkali, so in this, I found that the decomposition would not take place when water was used, nor by fusion. In the latter case, I found that the salt was so strongly attracted, that it quitted its water of crystallisation to unite to the metallic soap. If spirit of wine was added to this mass, a double decomposition took place, as already described.

Instead of sea salt, I added to diachylum GLAUBER'S salt, freed from its water of crystallisation by heat. I expected that it would have acted on the metallic soap more speedily than the sea salt; but the contrary appeared on trial. On adding a small quantity of sal sodæ, the decomposition went on better, and sufficiently to shew that the ingredients were capable of acting on each other. And I suppose, from your table, that other neutral and earthy salts will have a similar effect, especially if deprived of any superfluous acid by the addition of a little alkali or earth; though I have not made the trials.

Professor BERGMAN has divided his table into two parts; the affinities as they take place in the *moist*, and in the *dry* way. But these experiments shew, that in the *moist* way the affinities take place differently, according as water, or spirit of wine, is used. Perhaps a like difference would be found on using other liquids, each of which would probably afford a different table: for much depends on the attraction which the ingredients themselves have to the liquid employed, as I have endeavoured to shew in the work before referred to; for the liquid is to be considered as one of the ingredients.

I beg leave to add, Sir, that I think I have since hit upon a better method of making soap, and without spirit of wine; but as I have not yet made all the experiments on this subject that I intended, I cannot at present give you an account of them. If they succeed, I will take the liberty to acquaint you with the result.

I am, Sir, with the greatest respect, &c.

J. ELLIOT.

Great Marlborough-Street,

October 31, 1785.

P. S. Since writing the above I have found, that if mild fixed alkali be added to diachylum in hot water, they unite into a gelatinous mass, which is miscible with the water. This may be considered as a kind of *bepar*. If this substance be put into hot spirit of wine, the decomposition already described takes place. If chalk be substituted for alkali, there is a similar result. I have found that nitre is decomposed by diachylum in spirit of wine. I have also found, that if the compound of diachylum and common salt be put into hot spirit of turpentine, the diachylum is dissolved, but the salt remains at the bottom of the vessel.

