

VI.—*Observations on a remarkable change which Metallic Tin undergoes, under peculiar circumstances, and on its partial conversion into a Muriate of Tin.*

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I BEG leave to submit to the Society some observations on a remarkable change which metallic tin undergoes that has long lain under the surface of the earth, and on its partial conversion into a *muriate*.

I shall not trespass upon the time of the Society by entering into the minutiae of chemical analysis, much less shall I indulge myself in the reveries of speculation and conjecture. I shall merely state some facts which may excite their attention, and direct their enquiries to this particular subject; so that when the peculiar circumstances under which the phenomena in question take place, are clearly ascertained, we may be furnished with data on which we may found our reasonings, and approxi-

mate more nearly to probability when we attempt to connect effects with their corresponding causes.

The first instance in which I saw *muriate of tin*, occurred in a specimen of what is usually called "*Jew's House Tin*;"\* it was kindly presented to me many years ago, by Mr. John Michell, of St. Austle. It was amongst other lumps discovered under the surface of a low and boggy ground in the parish of Kea; the tin was accompanied with a stratum of charred wood or charcoal. The first thing that struck me in this mass of tin, was a vein of saline matter that ran through it; this saline matter I found to my astonishment to be *muriate of tin*. The whole mass evidently appeared to be in a state of decomposition. There was also a marked gradation in the several changes which the metal had undergone; one part of the mass had the appearance of metal, which, although some change had taken place in it, could, to a certain degree, be extended under the hammer. This metal in the next layer, began to be split into fragments, which still adhered together;

\* It may be necessary to state the meaning of the term "*Jew's House*." It is a plot of ground that has been hollowed out, and is found to contain ashes and often fragments of metallic tin, which has given rise to the fallacy respecting the discovery of that metal in a native state; these ancient remains of the places where tin was formerly smelted by the Jews, are frequently found in different parts of the county.

they occasionally exhibited spots of the colours blue and yellow. The next layer was still further changed, as it had assumed the appearance of a brown earth or oxide, through which a white brilliant salt shot, here and there, in mammillary protuberances. Next to this brown oxide a regular vein of crystallized salt occurred; it was of a yellowish hue, and was compact and hard; the vein was nearly one fourth of an inch in thickness. The outer surface, to which it was strongly attached, was also about one-fourth of an inch in thickness; was black, and so hard that angular fragments of it were capable of scratching glass. I do not mean to affirm that these several states or stages of progressive decomposition or change in this mineral substance, were so *distinctly discriminated* as not here and there to run into each other, for this indeed was true with respect to all, except the hard black matter, which lay next to the vein of muriate of tin; the line of separation was *here* distinctly marked.

The *metallic tin* has, evidently, undergone some change since the mass has been in my possession, and some saline matter has shot forth from the brown oxide, and still continues to shoot.

The form of the crystals of this *muriate of tin* appears to be that of square laminæ, the opposite angles of which are frequently truncated. These laminæ are closely packed together in a mass in the vein of the salt before mentioned.

In some pieces, where there has been a fissure in the mass, these laminae are distinct, and the salt is very beautiful as it assumes a silvery brilliancy. These crystals, and the black hard substance to which they adhere, might be easily mistaken, even by an experienced mineralogist, for a natural production, in the strict and usual sense in which the word "*natural*" is employed in such cases; nor is it probable that he would be competent to decide upon the nature of the fossil, much less upon the origin from which it had been derived. This muriate of tin is almost totally soluble in distilled water; a small portion of oxide remains undissolved; whether this residuum arise from the salt being not quite pure, or from a change in the oxidation of the tin, produced by the process of solution, I do not know; liquid nitrate of silver, dropped into a solution, recently made, produces a copious precipitate of a chesnut colour. After some time a portion of the oxide of tin is separated, and *then* the precipitate effected by the nitrate of silver, is not tinged brown, but is white. I could by no means satisfy myself with respect to the chemical analysis of this *muriate of tin*. In addition to the difficulty (I may say impossibility) of accurately ascertaining the amount of the muriate acid by means of the *nitrate of silver*, for the reasons given by one of our members, Dr. John Davy, in his masterly observations on the combinations of different

metals with chlorine; another source of error arose from the intrusion of small particles of tin, and of the brown oxides, a circumstance which would preclude accuracy, in any estimate formed by means of *inference and calculation*, from the quantity of tin found in the salt. I melted twenty-five grains of this salt, freed as far as it was possible from extraneous matter, with double its weight of the purest carbonate of potash that had been dried in a red heat; in a platinum crucible; extracted the soluble part by means of distilled water, and rendered the solution slightly acid by dropping into it pure nitric acid. Liquid nitrate of silver dropped into it separated muriate of silver, which, after having been perfectly dried, weighed 12.6 grains; but I have reason to think that all the muriatic acid was not separated by the alkali, and therefore that the relative amount of muriatic acid in this salt is not duly represented by the muriate of silver. The oxide of tin which remained after all the soluble part had been washed out, resisted the action of muriatic acid with singular obstinacy. The brown oxide before mentioned, contains muriatic acid, as we might suppose from the circumstance of crystals of *muriate* of tin shooting out from it. Some nitric acid of moderate strength was poured on some of it reduced to powder; I was surprised to see that the acid dissolved the greater portion of it, and retained it in solution also, even after it

had been considerably diluted with water. A drop of liquid nitrate of silver threw down a precipitate of a deep chocolate brown colour. I separated an abundant quantity of oxide of tin from another portion of this solution by means of ammonia; the residuary fluid, after being neutralized by nitric acid, was assayed with liquid nitrate of silver, which separated muriate of silver, no longer tinged brown, but which was white.

I have seen some other masses of "*Jew's House Tin*" in an early stage of decay, wherein the metallic tin was breaking into fragments, and gradually passing into an oxide; but I doubt not, but that under favourable circumstances of time, &c. they would have advanced through all the stages of change before specified. Nitric acid poured upon some of this partially decayed metal, converted it into a white oxide; the soluble part was then extracted by distilled water; liquid nitrate of silver dropped into it separated a precipitate of a chestnut colour; it consisted of oxides of silver and tin, a *trace* also of the presence of muriatic acid was discovered, which was still more evident when some of the same substance was fused with pure potash, &c. &c. This agrees with the result of trials made upon portions of the mass first mentioned, which was in the first stage of decay. I have seen other lumps still farther decayed, in which I could here and

there detect a few crystalline laminæ. I was much struck by a passage which I met with in Mr. Phillips's ingenious and scientific memoir on the *oxyd of tin* in the second volume of the Transactions of the Geological Society of London—" This specimen (of supposed native tin) seems very much to agree with some found in France by Schreiber, an account of which he has given in the *Journal des Mines*, except that those were accompanied by a white substance, which proved to be white muriate of tin."

It appears then from what I have had the honour of submitting to the Society, that the gradual conversion of tin into a muriate, is not an isolated fact : but there seems to be in this metal a tendency to change, a liability to very gradual and progressive alteration, *under peculiar circumstances*. What *all* these circumstances are we are not warranted by adequate data to affirm. I will, however, hazard one observation ; it is this, that the pieces of tin which I have seen undergoing the change, have all agreed in this one particular, that they were found under the surface of boggy ground, where we may suppose that sulphuretted hydrogen gas is generated. It has indeed been suggested to me that the muriatic acid may owe its origin to muriate of soda, which might have been used as a flux for fusing the metal. The probability of this supposition seems to be negatived *a priori* when we consider how rude

and summary the process of fusion was in ancient times ; the stratum of charred wood which generally accompanies these lumps of tin, proves that the ore was not confined within the limits of a furnace, but exposed to an open fire. If muriate of soda had been employed and decomposed, some traces of the presence of soda would be discoverable. On my employing the usual modes, I could detect no trace of it, or of potash.

I flatter myself that the Geological Society of Cornwall will consider the facts which I have submitted to them, not altogether uninteresting, and that they will deem them worthy of being followed up by further and more scrupulous investigation. An accurate examination of the spots where *such* lumps of tin have been found, and a more minute and rigid analysis of them in the several stages of change, both by the ordinary methods as well as by the means of pneumatic chemistry, might afford some interesting results, and possibly lead to some curious conclusions, which might tend to establish truths of *general application*.

It cannot be expected that we can produce in our laboratories any change in tin similar to those changes which I have described ; for chemists cannot call to their aid an auxiliary essential to such a process ; I mean that silent, secret, yet powerful agent, TIME.

I ought to apologize for using some antiquated terms in this paper, such as muriatic



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acid, &c. which are now superseded by terms more appropriate, *chlorine*, *stannane*, &c. ; and above all I feel that an apology is due for the jejuneness of this paper ; the fact is, that the few experiments which I made on the tin were made some time ago, and for a long season I have been prevented from extending and multiplying them ; but I choose to send this memoir *with all its imperfections on its head*, rather than to omit an opportunity of shewing my respect for a Society so eminently calculated to promote the interests of the county, and of which I have the honour of being a member.

*Creed, September 7, 1816.*

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Since writing the above, I have visited Menabilly, where I saw two specimens of "*Jew's House Tin.*" Both were in a state of gradual and apparently increasing decay, and both contained crystals of *muriate* of tin ; one of the specimens had a vein of this salt running through it, beautifully crystallized. I could not learn whence these specimens came ; they were, however, supposed to have been found in a low swampy ground.

*February 12, 1817.*