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ON
THE TOXICOLOGICAL RELATIONS
OF THE
SULPHOCYANIC ACID.

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In the following observations, my principal object is to point out the peculiar circumstances under which the extreme sensitiveness of the meconic acid to the persalts of iron, may be rendered a *certain* test of the presence of opium in medico-legal inquiries. That further remarks on this subject are not entirely superfluous, is proved by numerous and convincing reasons. To these, however, I shall not now advert, as they will show themselves sufficiently and more appropriately as we proceed.

In the first place, then, I shall very briefly enumerate the chief chemical peculiarities by which opium and its solutions are distinguished.

I shall next consider the principal imitative actions which, taking place between other substances, interfere with the decisive character of the evidence thus detailed.

Finally, I shall notice the leading processes recommended by toxicologists for its detection, and either point out or explain how far each process is affected by the sources of fallacy which shall be described.

To many, I am aware that a recapitulation of the chemical constitution of opium is entirely unnecessary; but as there is at least an equal number to whom this repetition may be desirable, I shall proceed with it, though with the utmost brevity, and only so far as the chemical relations of the drug are toxicologically concerned. The two most remarkable ingredients of opium, are morphia and meconic acid, which exist together in the state of a neutral saline combination. The separation of the meconic acid from the solutions of opium, is easily effected by the agency of lead, with which it forms an insoluble compound, so that the addition of the acetate of lead to a solution of opium, causes an interchange of elements; the meconate

of morphia is decomposed, the insoluble compound of meconic acid and lead subsides, and the acetate of morphia remains in solution. If this meconate of lead be now subjected to a stream of sulphuretted hydrogen gas, the acid is set free, and may be obtained by filtration and subsequent boiling. This solution is now found to possess peculiar properties, it reddens litmus, and with the persalts of iron assumes an intensely red colour.

To this latter property of the meconic acid, toxicologists have justly directed their principal attention in their search for a method of detecting opium in complex admixtures; as if, however, to baffle the industry of chemists, it has long since been discovered, that the sulphocyanic acid and its salts possess the same action with the persalts of iron as the meconic acid, and that with an equal, if not superior delicacy; and, what is of the first importance, that the sulphocyanate of potass exists in the saliva, the bile, and other animal secretions. An evident source of fallacy thus presented itself,—if not in actual analysis, at least in the logical precision required in medico-legal testimony. Though lawyers have availed themselves of the notice taken of the fact, in works on forensic medicine, yet no attempt has been made to ascertain whether the sulphocyanate of iron might be formed at all during the process for detecting opium, and, if so, how the two salts (the meconate and sulphocyanate of iron) might be distinguished from each other.

To remedy this defect, I have applied the several processes recommended for detecting the meconic acid; first, to solutions containing the sulphocyanate of potass; and, secondly, to the animal secretions which are asserted to contain that substance. The results of these experiments I now communicate under the impression that they may be of some practical utility, both as far as regards the discarding of deceptive processes, and the further elucidation of one which has received the sanction of the most distinguished of all authors on the chemistry of poisons. †

† Vide Christison, p. 616.

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Three modifications have been recommended in the application of the iron test to solutions suspected to contain opium. The first is the direct addition of the permuriate of iron to the fluid under examination; the second is the precipitation of the fluid by the acetate of lead, and the decomposition of the precipitate by the sulphuric acid; the third differs from the second essentially, in this decomposition being effected by the sulphuretted hydrogen gas.

To the first of these methods there exists one great and almost palpable objection, namely, that the saliva contains the sulphocyanic acid in combination with potass in such a quantity, that the addition of the permuriate of iron is sufficient to change it to a deep blood-red colour. It is strange that though this fact has been long known, it has only been noticed in the most superficial manner by the recent writers on the detection of poisons. Thus Dr. Christison, speaking of the meconic acid and its effects on the persalts of iron, dismisses this fallacy in the following words:—"Only one other acid is so affected, namely, the sulphocyanic, a very rare substance." I have also often found evidence of the sulphocyanates in the mucous fluid remaining attached to the villous coat of the stomach, and it was moreover remarkable that this fluid had, in all these cases, an acid re-action on the litmus test. For these reasons I believe it will be admitted that the direct addition of the permuriate of iron to a suspected fluid, can never afford satisfactory indications of the meconic acid.

The second modification of the process is also liable to some important fallacies. The acetate of lead, added to various organic fluids, while it precipitates the muriates, phosphates, &c., which they contain, also causes an abundant deposition of organic matters, especially albumen and casein. If to a precipitate of this kind strong sulphuric acid be added (in the quantity recommended by the proposer of this method of decomposing the meconate of lead), the fluid will, in a very short time, assume a reddish tint, not at all dissimilar to the meconate and sulphocyanate of iron. This effect is produced by the action of the sulphuric acid on the albumen attached to the metallic precipitate, an action first pointed out by Dr. Hope, the professor of chemistry in the University of Edinburgh, but never before (at least as far as I am aware) applied to the elucidation of difficulties in this department of analysis. Its importance is, however, by no means trivial, as it is concerned, not only in the search for opium, but in several other analogous investigations. On a late celebrated inquest, I was intrusted with a portion of skin for analysis, to which it was supposed some irritating

and deleterious liniment had been applied. On this skin, and the fluid in which it had been preserved, I instituted a series of experiments, so devised as to comprehend their indications, arsenic, antimony, copper, silver, and the corrosive acids. The reddened litmus slightly, and contained starch in solution, resulting from some articles of a poultice which adhered to skin. Nitrate of baryta caused in this white precipitate, which, when treated while moist, with the nitric and sulphuric acids, became of a reddish colour, inclining to violet, precisely of the same tint as mixtures of the iodide of starch assumed in complicated mixtures. These phenomena strongly indicated the presence of hydriodic acid; but as the nitro-muriate of platinum was not affected by the fluid, and as, in subsequent experiments, I found the sulphuric acid to produce the same effect on several albuminous precipitates, I considered that sufficient source of fallacy existed in the experiments, to render inadmissible any testimony founded on their results.

To the third process I have in the last place to advert; it consists in decomposing the supposed meconate of lead, by sulphuretted hydrogen gas. It is recommended by Dr. Christison, and I am happy to be enabled to add my feeble evidence in support of its great superiority over every other hitherto recommended. Its chief excellence however, Dr. Christison has omitted to mention, and which consists, in the first place, in its entire freedom from the fallacy of the reddening of albumen by the sulphuric acid; and, in the second place, in the necessary removal of every trace of sulphocyanic acid, or its compounds, which is perfectly accomplished by the washing of the precipitate as he directs. Nothing can point out more strongly than this, the value of minute practical directions as to the manipulation of a toxicological analysis. In this instance, any sulphocyanate of lead which may have been formed, is dissolved away by the water employed in the ablation of the precipitate. Thus if the sulphocyanic and meconic acids be mixed together, and the acetate of lead be added, a precipitate falls down which, when washed carefully, and decomposed by sulphuretted hydrogen, affords the meconic acid. Again, if the fluid remaining after the precipitation be filtered, and tested with the permuriate of iron, it will afford the red sulphocyanate of that metal.

When I first commenced experiments on this subject, my object was to find out a method by which two red solutions of the same tint, one the meconate, and the other the sulphocyanate of iron, might be distinguished from each other. In the pure state this is easily effected by diluting both with distilled water, to a very light and

transparent degree of redness, and then adding a drop of an alkaline solution. The sulphocyanate immediately is bleached to a dead pale white,* while the meconate becomes turbid, and deepens in its tint. Again, the colour of the sulphocyanate may be restored by the cautious addition of a solution of chlorine, while the meconate does not resume its redness under the same treatment. To these experiments, however, I do not attach much practical importance, as, in the first place, they require extreme attention to the quantity of the permuriate of iron employed in striking the original red colour, as a minute excess of the salt of iron completely obscures the distinguishing characters thus described. In the second place, various animal fluids interfere with the actions to a very troublesome degree.

In conclusion, I may observe, that my aim in the preceding observations, has rather been to collect together some isolated and scattered chemical facts, and to apply them to the purposes of this particular branch of analysis, than to advance any novel or peculiar opinions. At any rate, attention to these facts and explanations may contribute in some degree to prevent the confusion which might be occasioned on a cross-examination, by interrogatories respecting the fallacies attributed to the agency of the sulphocyanic acid.

23, Hadlow Street, London,
27th September, 1830.

ON THE HEART.

By Wm. Dobson, Surgeon.

SINCE the time of Harvey, the action of the heart has been founded on sensibility. Though this organ is supplied with nerves which endow it with the power of involuntary motion, yet it is conceived requisite that some stimulus should be applied to bring it into play; and however paradoxical it may appear, it is nevertheless true, that the heart will continue its action when removed from the body.

The motions of the heart are conceived to result from the agency of the blood in its cavities, acting either by some inherent stimulus in the blood, or by distending the walls of the organ. For a considerable period I have been engaged in examining the nature of the circulation, but other necessary engagements have prevented me giving publicity to my observations; and I

should not, at the present, have intruded into the pages of THE LANCET, but for the notice of two theories on the heart's motion, by Drs. Corrigan and Hope; hoping, however, by the promulgation of my observations, to assist in solving that important problem, "the cause of the heart's stroke on the chest."

When opposite opinions are entertained by eminent individuals, we necessarily presume either that the question is so abstruse as to elude demonstration, or that their theories are deduced from false data. The latter conjecture I shall endeavour to prove is the case. It is imagined, then, that the heart requires some stimulus to excite it to motion. Not a more erroneous notion ever prevailed! It originated in the dawn of science, when the physiology of the nervous system was as imperfect as its anatomy was unknown. Such is the influence of the *nervi sympathetici* on the organ it supplies, that it not only endows them with the power of moving independent of the will, but it enables them to perform continuous alternate contractions and dilatations quite independent of every other material agency. I have alluded to a fact, that the heart will contract after its removal from the body; and I may adduce another equally valid in support of my position. Having introduced my hand into the thorax of a dog, I grasped the two *venæ cavæ*, so as to preclude the entrance of blood into the heart. What was the effect? Why the action of the heart was still maintained! Though somewhat enfeebled, it continued to dilate and contract alternately and regularly. The circumstance, which seemed remarkably peculiar, was, the *diastole*, both of the auricles and ventricles, was apparently more energetic than the *systole*. In this experiment I witnessed the following phenomena:—

1. That, during the *diastole* of the ventricles, the heart was visibly augmented in size; and that, during the *diastole*, it was when the stroke against the side of the thorax occurred, not only the apex, but the anterior surface of the heart, impinged against the thoracic wall.

2. During the *systole* of the ventricles, the heart diminished in size, and receded into the thorax.

Remembering that, as taught in the schools, this stroke of the heart against the chest resulted from the aorta endeavouring to straighten itself, when blood was thrown in, tilting the apex against the chest. To obviate this effect I grasped the *venæ cavæ*, and thus removed that attributed cause, but the phenomena occurred as before.

These experiments and observations were made at the least twelve months ago; con-

* I may remark here, that so great is the influence of alkaline or earthy carbonates over the colour of the sulphocyanate of iron, that the addition of Thames water, in an equal volume, will decolorize a deep red solution of that salt.