

lower down by the vena cava descendens, which separates the farther from it as this reaches the right auricle of the heart. It is subsequently covered only by the cellular tissue, the roots of the hyoid and sterno-thyroid muscles, the upper part of the sternum, and then a little by the sterno-clavicular articulation of the same side.

*Operations.*—1st. *Mott's Operation.*—An incision three inches long above the clavicle from the external edge of the sterno-mastoid to the front of the trachea, and then another incision of the same length on the inner edge of the sterno-mastoid, and joining the inner extremity of the first wound. Then divide the sternal portion, and also a part of the clavicular end of the sterno-mastoid, and turn it upwards and outwards. Having pushed aside the jugular vein, subclavian, and nerves, with the handle of the scalpel, you reach the innominate, and apply the ligature.

2nd. *Mr. King's Operation* is, however, the one which M. Velpeau justly prefers.

The operator, placed at the left side, makes an incision two inches long in the supra-sternal hollow of the neck, on the inner edge of the *left* sterno-mastoid, obliquely, from without inwards, or from left to right, dividing thus, successively, the skin, subcutaneous layer, superficial fold of the fascia cervicalis, cellular tissue, a second fibrous layer; then meets behind the sterno-thyroid muscle, the thyroid plexus, and the thyroid artery of Neubauer, where it exists, separates these vessels, or ties them if necessary, and arrives at the trachea. Then the left subclavian and right internal jugular veins present themselves, and are gently pressed upwards, and to the right side, with a probe. The surgeon bends the patient's head a little, and endeavours to recognise the artery by passing the index-finger between the trachea and the right sterno-hyoid muscle. He then isolates the concavity of the artery with the extremely slightly-curved probe, guided with the utmost gentleness between the artery and the descending cava. The same manipulation is repeated at the brachial side, to lay bare and elevate the posterior side of the vessel. The curve of the probe is now a little increased, and serves as a guide to the *porte ligature*, which may be directed from either side, taking the greatest care not to tear the pleura, to touch the nervus vagus, or to strain the subclavian vein.

This process M. Velpeau considers more simple, rational, and less dangerous, than any other hitherto proposed.

## ON THE PREPARATION OF IODIC ACID.

By JOHN S. HILEY, Esq., Elland.

THERE is, perhaps, no science, the different departments of which are taught by experiments, so open to exaggeration as chemistry. There is scarcely a discovery of any kind made in it, but its merits are exalted far beyond bounds, or the facility with which it may be accomplished is spoken of in terms which lead the youthful experimentalist to consider it as but the work of a moment, when at the same time there is, perhaps, nothing more complicated than the process by which it has been reached. Led on by the inducement which is held out to him, he is not aware of his inexperience until he finds himself bewildered in a labyrinth of delicate and perplexing experiments, from the minutiae of which nothing can free him, but the entire abandonment of the object of his labour. This step, however, he is unwilling to adopt, as the stimulus which first urged him on has not yet subsided, but in case he do not subsequently succeed, he then lays it aside in disgust, and fancies that those studies which, under other circumstances, were calculated to afford him pleasure, are an assemblage of wild and chimerical notions, accumulated by the few to deceive the many. He ever afterwards looks upon chemistry with a suspicious eye, regards its followers as the dupes of trickery and imposture, and abhors the science than which, Griffin, in the introduction to his *Chemical Recreations*, considers "none better calculated to encourage that generous love of truth, which confers dignity and superiority on those who successfully pursue it;" and though, as is beautifully observed by the same author, "no science holds out more interesting subjects of research, and none affords more striking proofs of the wisdom and beneficence of the Creator of the universe," he does not hesitate to regard it as the fountain-head of atheism and infidelity.

In this way has the ardour of many a powerful mind been damped. The hopes and ideas of the student are raised to their highest pitch, and if not fully satisfied, he may attach the blame to his own incompetency, or in the end begin to harbour a dislike to that science which otherwise he may have been fitted to adorn.

Discoveries, however, painted in false colours, and experiments, the difficulties of which are purposely concealed, though deceiving thousands of the young and inexpe-

rienced, will, nevertheless, after a time, in the hands of those who are possessed of stronger minds, be brought to their proper level, and the veil by which they are hidden be rendered so transparent that the eyes of all may behold them. Such also must be the lot of all discoveries which are hyperbolically treated. How foolish, therefore, how improper it is in the chemist to exaggerate them, and thus hide that science in a mist, which, when properly explained and demonstrated, is more simple and delightful than any other! Its laws are the offspring of the most satisfactory reasoning, and its fundamental truths have been thoroughly verified and established.

There is certainly no production in the whole range of chemistry so justly illustrative of these remarks as the formation of iodic acid. The truth of this asseveration may be immediately admitted when I inform my readers, that upwards of six different processes for forming this acid have been introduced to the notice of chemists since the discovery of iodine,—viz., The reaction of moistened iodine on euechlorine gas. The decomposition of the iodate of potash by sulphuric acid. Dr. Connell's process of boiling iodine in nitric acid, until no nitrous acid is evolved, then cooling the solution, and allowing the iodic acid to subside. M. Serullas' plan of using nitric acid, saturated with nitrous acid. M. Duflos' process, the best of all, of boiling iodine in nitric acid concentrated as much as possible, but exempt from nitrous acid. And, lastly, the method proposed by *Ovris* in the 506th Number of *THE LANCET*, which is merely a modification, or rather an improvement, of the second-named process. By all these it will be seen, that there is a great want of consistency, and instead of affording us instances in which chemists coincide in opinion, they only serve as the Editor of *THE LANCET* has beautifully and faithfully observed, "to illustrate the contradictions in which practical chemists often unhappily involve themselves."

With the exception of M. Duflos' method, as far as my own observations extend, the merits of these are nearly on a par. The repetition of the first is attended with extreme danger. The second is so troublesome and uncertain, that after hours of labour, in many instances, no results are obtained. I have never been able to succeed with Dr. Connell's method, though I have often repeated it; had he specified pure nitric acid, his process would have been successful. M. Serullas' mode of procedure is perhaps the least effectual. And the proposal of *Ovris* is, if anything, rather too complicated.

I am not now speaking theoretically, but from absolute experience. I have repeated all the processes but the first, I mean that of Sir Humphrey Davy, and can pledge myself as to the truth of what I advance. In every instance the iodic acid was altogether wanting, or the quantity obtained was too scanty to allow of the process being followed up. M. Duflos' method, however, repeated on my own plan, is free from this charge, and is probably the best and cheapest way of effecting the desired object. According to the statement of this chemist the nitric acid should be exempt from nitrous acid. This is not altogether requisite, as the deep straw-coloured acid will assist in the production of iodic acid as well as that which is colourless, provided it is concentrated as much as possible. The pure nitric acid sold by chemists never fails to answer. In the present state of chemical knowledge I cannot see any likelihood of improving this process. The iodic acid is not only plentiful, but readily formed, and did not the high price of the articles oppose themselves, I should not hesitate recommending it for general use. As it is, it may very likely be had recourse to, as being the cheapest process yet in vogue, and in that case, it is more than probable that some apparatus would be brought into use, capable of condensing the gaseous matter, and thus rendering the product as abundant as chemical skill would admit.

I will now state the result of some experiments on the formation of iodic acid, instituted at the suggestion of the editor of *THE LANCET*, on a pretty large scale.

To two ounces by measure, and nearly twenty-four drachms by weight, of concentrated nitric acid, and, consequently, of the specific gravity, as specified in my last article, of about 1.45, contained in a small retort with as long a beak as I could procure, I added exactly half an ounce of iodine. I then placed the whole over the flame of a spirit-lamp. Ere long it commenced boiling, and the iodine was sublimed on the sides and beak of the vessel. As fast as it was sublimed I washed it back, and thus brought it as much as possible within the action of the acid. I continued this operation throughout the whole process, and patiently waited the result. Nitrous acid vapours were produced in large quantities, and the quicker and more copiously they were given off, the earlier seemed to be the formation of the iodic acid. It is necessary, however, to restrain in some measure the evolution of this vapour, as it appears from experiment to carry along with it much of the iodine. This is best done by boiling the liquid gently, and occasionally blowing

down the beak of the retort when the vapour is being evolved. I have repeated the experiment both ways. In some instances I have allowed the vapour to evolve rapidly, and in others I have restrained it as much as possible. In the first, the iodic acid, though sooner formed, was not so plentiful at the close of the process as in the last, for from a drachm of iodine, the iodic acid obtained in the first way was less in quantity by several grains than that obtained by the second method. In three or four experiments the difference exceeded ten grains.

I am now deviating. In the experiment upon half an ounce of iodine, after about ten hours' continued boiling, that substance had all disappeared, and the liquid had become completely colourless. I saw the iodic acid gradually developing itself from the commencement of the experiment, and on now examining the contents of the retort, found it was much more plentiful than I at first imagined. I emptied the whole into a small evaporating dish, and after the iodic acid had subsided, poured off the supernatant fluid; I then washed and dried the iodic acid (the spicula of which were of the most beautiful crystalline texture, and glittered like spangles at the bottom of the dish) by a gentle heat, and on weighing the product in a just balance, found that the whole amounted to exactly 243 grains, or three grains more than the primary weight of the iodine. I would here observe, that a large proportion of the iodic acid obtained from the iodine experimented upon, is formed rather suddenly. After the boiling has been kept up for about half an hour, a few scales of that substance may be seen to subside, but on shaking up the mixture in order to wash back the iodine which may have sublimed, it is not unusual after examination to find that the iodic acid during that operation has been deposited in considerable quantities. This generally happens after nitrous-acid vapours have been copiously evolved.

From experiments since performed, I have every reason to suppose that about 240 grains of iodic acid are as much as can possibly be obtained from 1440 grains of concentrated nitric acid, or, in other words, that concentrated nitric acid will never change more than one-sixth, or, at furthest, one-fifth of its weight of iodine into iodic acid. I have since repeated this process in various ways. I was not content with performing it in a retort, but tried what would be the results in a Florence flask. In the last vessel, the loss of iodine in the form of violet-coloured vapour, was so great as to render the result far from satisfactory; for from half

the quantity of iodine, as experimented upon in the first instance, instead of obtaining 120 grains, I only got 80 grains of iodic acid. The iodine, instead of subliming on the sides and neck of the flask, escapes along with the acid vapours. This partly arises from the heat of the flask, which, however small or however distant the flame may be, is so great as to occasion a second sublimation; that is, after the iodine has once condensed, it is again expanded into vapour, and expelled by the increasing heat of the vessel. Occasionally it does not condense at all, but is driven out of the flask as fast as it arises from the fluid. Now the use of a retort with a long beak is free from this objection. It may be kept cool by means of wet cloths, and in this case not a particle of iodine can be detected by means of a magnifier, within five inches from its mouth. Apparently it is all condensed before it reaches that point, and, consequently, may be readily washed back without loss. But for all this a portion of iodine does escape, for the acid vapours are slightly impregnated with it. Here it is in the most minute division imaginable, as is indicated by the fact, that when a Florence flask was fitted pretty closely to the mouth of the retort, with its bulb at the same time in cold water, or even in a freezing mixture, not the slightest condensation of iodine took place; nor did a weak solution of starch point out in the least perceptible manner the presence of iodine. It was, however, readily detected, by placing a piece of moistened starch at the mouth of the beak of the retort. In a minute or two, sometimes more and sometimes less, according as more or less acid vapours were being expelled, the blue tinge was beautifully developed on the surface of the starch. In repeating this experiment, it is necessary that the beak of the retort, throughout the whole process, should be raised higher than its body, or a portion of iodine will be passed over with the watery vapour, in which case the experiment with starch cannot be satisfactorily exhibited.

From these experiments, and they were certainly repeated in the most careful manner, for I stood over them from first to last, it would seem that it is next to impossible to prevent the partial loss of iodine, as, in spite of all the cold I could apply by means of wet cloths, cold water, and freezing mixtures, it was carried away by the acid vapours. It was this circumstance which prevented me from discovering the proportions of oxygen and iodine in 100 parts of iodic acid; for though the quantity lost was too minute for either the eye, a magnifier, or any but a pretty fine balance to discern, yet the starch test

proved very satisfactorily that its presence in the acid vapour was at any time sufficiently plentiful to affect, in a considerable degree, whatever conclusions I might come to, and though Professor Stromeyer observes, that this test is so delicate that a liquid containing 1-450,000ths of its weight of iodine, receives a blue tint from a solution of starch, yet I am certain from what I have observed, that until the whole of the iodine can be condensed, so as not to be discernible by the test in question, no conclusions can be looked upon as decisive.

With respect to the most suitable vessel for forming iodic acid, in order to give the Florence flask a fair trial, I inverted a second over the one containing the materials; but even in this case the loss of iodine was considerably greater than when a retort was used. In using the latter, rags kept constantly wet with cold water were applied all along the beak. Probably Wouffe's apparatus might answer better than either. The gaseous matter might then be condensed, in which case it would prove a cheap and profitable process.

Before I proceed further, I must mention a rather remarkable phenomenon which showed itself in the course of this experiment. I have said that moistened starch received a deep-blue tint when placed in the beak of the retort. This only happened when colourless acid vapours, impregnated with iodine, were passing away; for when the orange-red vapour of the nitrous acid was being evolved, instead of the starch receiving a deeper tint, the blue colour was wholly dispersed, and the starch assumed its former shade. It was, however, altered materially in other respects. Instead of being of a loose texture, it had become sticky like gluten, as though iodic acid had formed on its surface by the union of the nitrous acid with the iodine. This however is but a supposition, for the glutinous consistence which the starch exhibits, cannot be wholly owing to the presence of iodic acid, as nitric acid alone produces it, nor would I have alluded to it at all, had I not imagined that the decoloration which takes place when the nitrous acid comes in contact with the starch, bore some relation to M. Serullas's plan for forming iodic acid, who recommends, as before stated, that nitric acid should be saturated with nitrous acid, by passing a stream of the latter through the former. From experiments since performed, I have found that the blue colour assumed by solutions of starch when iodine is added, is dispersed by the vapour of nitrous acid, however obtained.

In what has been said, it will be seen that the advantages and disadvantages of this process have been touched upon pretty largely; but in order to impress the particulars more certainly on the minds of my readers, I beg to repeat, that from half an ounce of iodine, and two ounces by measure of nitric acid of the specific gravity of 1.45, I obtained, after about ten hours' boiling, exactly 243 grains of iodic acid.

Now I take it for granted, that the experiment laid down in my last paper has been repeated, and I trust that each experimentalist has seen enough to admit of his putting some confidence in any assertions I may make here; but providing such is not the case, and they do suspect me, I beg they will repeat the process in question, and thus at once satisfy themselves respecting the claims it may have to the truth. Nor have I, I believe, in the least exaggerated. I trust that a repetition of the experiment will prove, that what I have stated is rather under than above the mark, that a trifle more iodic acid will be obtained rather than a trifle less, and that the time required in its performance, the difficulties arising in its course, and the carefulness necessary to ensure its success, have been rather exaggerated than otherwise. I have done this to avoid the repetition of a blunder into which most chemists have fallen—that is, disappointing rather than satisfying the expectations of junior students, and that the hopes of every reader of *THE LANCET* may be fully realized.

But after all this, I would guard against shining in borrowed plumes. From what has been said at the close of my letter (inserted in *THE LANCET* of June 1st, page 305), I imagine I have every reason to fear that the discovery of this process for forming iodic acid may, by the careless and unthinking, be attributed to me, whereas I have little or nothing to do with it. I am merely the repeater of an experiment, of the products of which, by the same means, M. Duflos is the sole discoverer; consequently I disclaim all title to praise, any further than what may arise from bringing back a process for the formation of iodic acid to the notice of chemists, which, to all appearance, was fast sinking into oblivion. All the merits of the discovery are entirely due to M. Duflos.

I will now proceed to make a few observations upon iodic acid. They are the result of a patient investigation of it, and I trust will be found to come pretty near the truth.

In my letter, in the 509th Number of *THE LANCET*, page 305, I stated that iodic

acid reddened vegetable blue colours, and afterwards destroyed them. This is a mistake which I beg to remedy, for I find, after repeating the experiment more than half-a-dozen times with greater ease, and on a much larger scale, that it possesses no bleaching properties over litmus. How it happened that I made out the contrary beforetime, I cannot possibly guess, unless it arose from the presence of some extraneous substance. Be this as it may, it certainly cannot boast of any decolorizing powers over that preparation. I was the more surprised at this, because it was in direct opposition to the statement of Sir H. Davy, in whose opinion all chemists, I believe, have hitherto confided.

Dr. Turner has the following passage in the second edition of his *Elements of Chemistry*:—"Iodic acid deliquesces in a moist atmosphere, and is very soluble in water. The liquid acid thus formed reddens vegetable blue colours, and afterwards destroys them." Mr. Boswell Reid concurs in the same opinion; for in the second edition of his *Elements of Practical Chemistry*, he observes that "it is soluble in water and deliquescent, and reddens, and then destroys, the vegetable blues." Now I am convinced that Dr. Turner, Mr. Boswell Reid, and all other chemists who join in their opinion, labour under a great mistake; and to prove this, I need only add that I dissolved upwards of 100 grains of iodic acid in as small a portion of distilled water as possible, and then dipped a piece of litmus paper into the solution. It was instantly reddened, but never lost a shade of this last colour, though it remained soaked in the solution for more than four days. I repeated this experiment in various ways, sometimes with the tincture of litmus, and at others with litmus paper, but could never observe that it was in any one instance in the least decolorized. Iodic acid, however, reddens, and then bleaches, the tincture of cabbage, and perhaps to this property are owing the statements of Sir H. Davy, Dr. Turner, and Mr. Boswell Reid.

On evaporating solutions of iodic acid, a thick mass, of the consistence of paste, remains. This property is better and more readily exemplified by exposing the acid to the air, and thus allowing it to absorb a small portion of vapour. The hydrous iodic acid is soon formed, and its singular pasty consistence exhibited in a really beautiful manner. It is then tough and elastic like gluten, which property is perhaps the most likely to distinguish it when formed from any other substance. It is no easy matter for a youthful experimentalist to make out the uncommon compounds. He may have already formed

them, and not be aware of it, such are the discrepancies of most guide works in chemistry; but as regards iodic acid, he need never be at a loss, since this quality, when united with a small portion of water, will enable him to discover it at once.

Iodic acid is instantly decomposed by solutions of arsenious acid, and iodine is set at liberty.

Solution of tartar emetic throws down a white precipitate from solutions of iodic acid, which, on adding a particle of starch, becomes of a fine dark-blue colour. A strong smell of iodine is, at the same time, given off. This is a beautiful experiment, performed on a watch crystal. A minute drop of fluid, scarcely visible, suddenly becomes of a deep blue, appearing at the same time much more plentiful than it really is.

Nitrate of mercury throws down a copious white precipitate from iodic acid in solution, which, on the addition of a little starch, changes in a short time into a blue, thus indicating in the most satisfactory manner the decomposition of the acid, and the presence of iodine.

Iodic acid unites with strong caustic ammonia, forming with it instantly a white substance, iodate of ammonia, of a beautiful crystalline appearance, almost as plentiful as the liquid.

Spirit of wine along with solution of bi-chromate of potash produces a white precipitate with iodic acid.

Upon solutions of chromate of potash this acid has the same effect as all the other acids. By taking away an atom of the base of the latter, and thus forming iodate of potash, it imparts to the yellow liquid a beautiful orange-red colour.

Prussic acid has no sensible effect upon iodic acid, but a solution of terro-prussiate of potash decomposes it, giving rise to a greenish-white precipitate. Iodine is at the same time set at liberty, and may be detected by the usual test and the smell.

From most of the above experiments it would appear, that the affinity of iodine for oxygen is much inferior to the affinity which the latter has for many other substances. The facility with which it is decomposed by most deoxidizing agents, amongst which we may enumerate some above noticed, serves to prove this satisfactorily. The compounds into which it enters are also not less readily decomposed, as those of potash, soda, ammonia, and baryta; and in accomplishing this, arsenious acid, &c. appear deserving of as conspicuous a place in the class-books of chemistry, as the more powerful ones of sulphurous, phosphorous, and hydriodic acids.

Elland, near Halifax, July 15th, 1833.