quantities. Much of the pitch manufactured on the island is taken from the lake. When thrown into heaps it runs together into a solid mass. And the place from which it is taken, although near the side of the lake where the pitch is hardest, gradually fills up again by the pressing in of the surrounding mass. The supply being so large and so easily attainable, it must continue for ages of vast economic importance.

Art. IX. On some Recent Improvements in the Amalgamation Process for Extracting Gold from Quartz.

By George Lawson, Ph. D., L. L. D., *Professor of Chemistry, Dalhousie College.*

[*Read March* 8, 1866.]

The paper was chiefly occupied with a discussion of the properties of the metal Sodium, (Na.) and of the Sodium Amalgams, and of the use of the latter in promoting the amalgamation of Gold.

The metal sodium, a discovery of Sir Humphrey Davy, was particularly described, and the method of removing it from its combination with oxygen. It was prepared by decomposing carbonate of soda by means of charcoal, at a high temperature, this last having a greater affinity for oxygen than sodium. The use of sodium in the arts has so diminished its price that it can now be obtained at 6s. stg. per lb. Specimens of large size, contained in naphtha, were exhibited. Its colour is silver white, sp. gr. 0.972—it is as soft as butter at the ordinary temperature of the atmosphere, fuses at 194°, and oxidizes rapidly in air. It burns on a slight increase of temperature. Several interesting experiments of its fusion and burning were exhibited. It decomposes water rapidly, uniting with the oxygen it contains, and liberating the hydrogen. The Doctor illustrated its action on water by some beautiful experiments,—amongst others, by the preparation in course of a few minutes of a large jar of hydrogen gas, by the action of sodium upon water; the hydrogen was afterwards exploded to show the converse of the experiment. The property of sodium in promoting the action of mercury and amalgams upon other metals had been known for many years. Recently, however, Mr. Crooke, F.R.S., a distinguished chemist, who had discovered the metal thallium, has applied sodium

to the purpose of gold amalgamation. The Doctor here explained the ordinary process of separating the gold from the quartz, by using mercury alone, a process which was often inefficient, owing to the presence of sulphides, which, coating the gold, prevented the action of the mercury upon it. It was found by Mr. Crooke, that by combining the sodium with mercury, an amalgam was formed that had much greater power of taking up gold than mercury alone. By means of a sand bath and a glass vessel, the experiment of combining the mercury and sodium was shown to the meeting, and a considerable piece of amalgam made with the requisite proportions of mercury and sodium; and the action of the amalgam so made was shown on thin slips of gold freshly annealed, from the Waverley mines. It was shown that these slips of gold were not at all affected when drawn through ordinary mercury; but the moment they came into contact, however slight with mercury to which some of the sodium amalgam had been added, they were completely and permanently coated with mercury. The following was the account given of Mr. Crooke's process, which had been fully investigated by an extensive series of experiments in Professor Lawson's laboratory, and so favourably reported upon that a patent has been granted:—

"This invention relates to certain improvements in the method of treating the ores or substances containing gold and silver by amalgamation, and whereby those metals can be more perfectly and completely extracted and separated therefrom, than by the processes hitherto adopted. A solid amalgam of sodium is in the first place formed by combining about one part of sodium with about thirty parts by weight of mercury. The solid amalgam thus formed is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantity of metal contained and the state in which it occurs in the ore or matrix. If however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid and its manipulation inconvenient. The effect of thus combining the sodium with the mercury, is to impart to the latter a greater affinity for or power of adhesion to the metal under treatment, than it possesses in its simple and uncombined condition. Instead of using the solid amalgam as hereinbefore mentioned, the sodium may

be combined directly with the mercury employed, the proportions varying according to the requirements of the case.

"This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and in cases where amalgamating vessels or receptacles constructed of iron are employed, an additional advantage arises from the fact that mercury combined as before mentioned with sodium forms a thin film over the surface of the iron, thus collecting very minute quantities of the metal under treatment, and which may be removed by the ordinary process, and subjected to the subsequent treatment usually employed.

"The mode of treatment employed is as follows :—An amalgam of sodium is in the first place formed by combining sodium with mercury. The proportions may be varied within wide limits, that is to say, from less than three to more than thirty parts of sodium to one hundred parts by weight of mercury. The sodium and mercury must be caused to unite, and the amalgam prepared with the customary precautions well known to and understood by chemists. The last mentioned method of forming the sodium amalgam is that which the inventor usually prefers in actual practice ; but, if desired, the amalgam may be prepared electro-chemically, as described by Becquerel and other chemical authors, or by any other suitable means. The amalgam is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantities of precious metal contained, and the state in which it occurs in the ore or matrix ; but as in the process the beneficial effects of the sodium are gradually removed, the action should be maintained, if needed, by occasionally introducing fresh supplies of the amalgam into the charge of mercury contained in the machine employed. The quantity must, however, be regulated and determined by the skill and judgment of the operator, as no definite and absolute proportion can be laid down as necessary. If, however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid, and its manipulation may be inconvenient. The effect of thus combining the sodium with the mercury is to impart to the latter a greater affinity for or power of adhesion to the precious metal under treatment than it possesses in its simple and uncombined condition, so that it will readily amalgamate with the gold or silver, even when

the latter metals are soiled by grease or other extraneous matter. Although he prefers that the amalgamation shall be conducted in the presence of water, as in the usual processes, the operation, if desirable, may be performed in a dry manner. The amalgam above mentioned should be stored in air-tight vessels, or under naphtha, such as metallic sodium is usually kept in. Instead of using the amalgam as hereinbefore mentioned, the sodium may be combined directly with the mercury employed, care being taken that the proportions shall remain substantially as already indicated.

"This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and, in cases where amalgamating vessels, or receptacles or places constructed of iron or other metal are employed, an additional advantage arises from the fact that the mercury combined as before mentioned with sodium forms a thin film over the surface of the iron or other metal, thus aiding in the collection of any minute quantities of the precious metal under treatment. The subsequent extraction of the gold or silver from the mercury may be conducted in any desirable manner. It is not found in actual practice that a small quantity of sodium, if accidentally allowed to remain in the mixture with the gold or silver and mercury, affects the subsequent treatment in any appreciable degree. In cases where, from the nature of the ores or substances under treatment, the mercury used for amalgamation becomes divided into minute globules, technically known as "flouring" or "granulating," there is frequently a difficulty in separating the globules from the heavy particles of the powdered ore or substances containing the precious metal; the addition of the sodium amalgam to such a mixture is found to induce the coalescence of the liquid or viscid metallic particles, so that a mechanical separation of the gold or silver amalgam from the gangue may be readily effected. The employment of sodium in combination with mercury will especially be found beneficial in cases where gold or silver occurs with pyrites, sulphurets or minerals containing arsenic, antimony, tellurium, or bismuth. The process of amalgamation with ordinary mercury is difficult to perform in the presence of such minerals without great loss both of mercury and of the precious metal under treatment, owing to the surfaces of the latter being in such a tarnished or soiled state that mercury

alone will not touch them (as, for instance, when gold exists in pyrites). and also owing to the mercury becoming what is technically termed "sick" or "floured," in which state its power of uniting with the precious metals is much diminished; in these cases the addition of sodium amalgam will be found highly advantageous; whenever the mercury has become "floured" or powdered by the result of distillation, or from any other cause, it is readily restored to the liquid or bright metallic state by the addition thereto of sodium, either in its simple metallic condition, or as an amalgam with mercury.

"Although sodium is mentioned as used in the processes above described, other alkali metals, such as potassium and lithium and other metals strictly analogous thereto in their chemical and physical characters, may be employed in lieu thereof in combination with mercury for the purposes of this invention.

"Having thus fully declared and ascertained the nature of his invention, and the manner in which it is to be performed, Mr. Crooke claims that what he considers novel and original, and therefore as constituting his said invention, is, the employment of an amalgam of sodium, or such other alkali metal as aforesaid, in treating ores or substances containing gold or silver for the extraction and separation therefrom of the precious metals, as hereinbefore substantially set forth and described."

Dr. LAWSON, then explained the simplest methods by which chlorine and hypochlorous acid might be generated for sanitary purposes; and Mr. Outram described the process of manufacture of chloride of lime as conducted in the great works at Glasgow.

6th SEPTEMBER, 1866.

P.S.—Professor Lawson has requested the Secretary of the Institute, to insert the following memorandum of some further results in regard to Mr. Crooke's Process, which is now coming into use in our Gold Mines:—

"Experiments have lately been undertaken at the Lake Major Company's Mines, Waverley, with the view of testing in a practical manner the value, or otherwise, of Crooke's new process of amalgamation by means of sodium-amalgam. The crusher and other machinery of these mines being much superior to those of any simi-

lar establishment in the Province, the best opportunities have been afforded for a fair trial. The experiments have been carried out by Dr. Krackowizer, the manager of the mines, in conjunction with Prof. Lawson of Dalhousie College, whose laboratory investigations of the process were detailed sometime ago to the Institute of Natural Science. The results are highly satisfactory, and fully confirm the favourable opinion that has been formed of Crooke's process, and of its adaptability to Nova Scotian ores. One great advantage of the process is the action of the sodium amalgam upon pyrites, which material abounds in our quartz veins and is known to contain gold, but has hitherto been accumulating around the mines in enormous quantities as a waste material. A portion of this material operated upon by the new process gave at the rate of 5 *ounces of gold per ton of pyrites*. This is regarded as a remarkable result, and one that will certainly lead to the profitable extraction of gold from pyrites, especially as no extra apparatus is needed such as would be necessary for the chlorine process."

No. X. On the Food Fishes of Nova Scotia. No. IV. The Trouts and Salmons. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.,

[*Read April* 2, 1866.]

I have identified five species of the genus *Salmo*, as inhabiting the fresh and sea waters of this Province. They all closely resemble each other, in their powerful tail, and strong muscular back, their armature of numerous and recurved teeth, their tendency in the young to vertical markings, and the most of them to spots,—by all having the false or internal opercle as noticed by Muller,—by all spawning in November,—and all requiring highly ærated water in which to deposit their ova, thus seeking shallow streams of swift running water,—by hunting for their food singly, or in small numbers,—by a common voracity, and boldness, all with one exception having the power of throwing themselves several feet above the surface of the water,—by all seemingly enjoying life, and parting with it by fierce struggles—this last making them game-fish,—and lastly, by all of them being marked by a fatty fin, without rays, a typical mark whose use we cannot explain, and which they share with the very kindred geni of *Corregonus*, and *Thymallus*.