institution of their creation, and she need not fear but that by them she will be amply sustained.

My remarks have only been directed towards pointing out one of our most pressing needs—a need, to meet which would vastly increase our usefulness, and one which does not require any very large sum of money to supply. The larger wants of our school hvea recently been pointed out by Dr. Dawson and I need not refer to them here. There remains, however, one further development of our work which should not be long delayed, and which has not been publicly referred to.

If we are to keep abreast of the requirements of our time, we should very soon establish a course in Electrical Engineering. Such work is being taken up all around us. Cornell and the Massachusetts Institute of Technology have completely equipped schools. The Stevens' Institute is just about establishing one.

Our Faculty of Arts possesses a valuable collection of electrical and other physical apparatus, and is no doubt alive to the necessity of founding a physical laboratory. If this were done, and our mechanical laboratory properly equiped, a course in Electrical Engineering could readily be provided for.

Our school of Engineering was the first of its kind to be established in Canada ; for a time it stood without a rival, but during the last few years it has not been without competition. It is no boast to say that at present we are head and shoulders above our competitors, but if we would retain so honorable a position, it behooves us to study earnestly the educational requirements of our country, and to make fitting provision therefore. We have many advantages, and, we must not conceal it, we have some disadvantages. Amongst our advantages, we count it not the least that we have the wise counsel, the never-failing watchfulness of one to whom we all owe much ; he to whom our school owes its birth, whose fostering care has brought it through the period of infancy, and who now, in the days of its youth, spares neither his time nor his money to forward its objects—our Principal, Dr. Dawson. May we, be it at ever so great a distance, follow his example.

Gentlemen, farewell '

CHARCOAL AS A FUEL FOR METALLUGICAL PROCESSES.*

BY JOHN BIRKINBINE.

(*Concluded from Page 102.*)

Comparisons of the operation of blast furnaces show that not only is the fuel consumption per ton of pig iron less with charcoal than with mineral fuels, but that the output is greater per cubic foot of capacity, although the bulkiness of charcoal prevents as much ore being in the furnace at a given time as is possible with mineral fuel.

Having considered the quantity of this fuel now used and its quality, the methods of manufacture may receive attention. Formerly all charcoal was made in heaps or meilers. In American practice kilns are rapidly superseding the more wasteful method, and retorts are now taking the place of kilns and meilers in many cases.

Meiler charring should not be employed except under peculiar conditions, and it has been fully described in the *Handbook for Charcoal Burners*, by Svedelieu.

Professor Egleston presented to the Institute, at the Pittsburgh meeting, in May, 1879, a very complete paper on "The Manufacture of Charcoal in Kilns." It is, therefore, only necessary at present to consider the system of carbonization in retorts and compare it with the other processes.

At the Lake George meeting of the Institute, in October, 1878, I presented a paper "On the Production of Charcoal for Iron Works," in which the subject of carbonising the wood in closed vessels was considered and reasons were advanced for the more general adoption of this method. During the discussion which followed it was claimed that the collection of acetates was not practicable when charcoal was manufactured for commercial purposes. It is now my privilege to state that the production of charcoal is successfully carried on both in kilns and retorts, and the acetic vapors arising from the carbonization are condensed and made into commercial products.

There are now in operation at the Bangor Furnace, Michigan, fourteen kilns of eighty cords capacity, in which 16,000 cords of wood are annually carbonized, and the Elk Rapids Furnace, Michigan, also has 22 one hundred cord kilns in which 40,000 cords of wood are each year converted into charcoal ; the acetic vapors being exhausted from all of these kilns by Peirce's patent method and converted into acetate of lime and methylic alcohol. The two plants produce daily 17,000 pounds of acetate of lime and 250 gallons of alcohol. In addition, the Elk Rapids furnace has 3 one hundred cord kilns and 10 sixty cord kilns which are not constantly in use.

That the charcoal is not deteriorated by the collection of the acetic vapors is proven by the reports of the managers of these plants and by the remarkable records made by both these furnaces. It is doubtful if any other charcoal blast furnace in the country can show as good work for four consecutive years as that at Bangor. Concerning the discussion above referred to, Major Pickands, the manager, says: "We do not extract acetic vapors, nature throws them off from the wood in process of carbonization, whether that process takes place in a kiln, retort, or dirt pit, and we capture the vapours and utilize them."

The financial success of the chemical department at Bangor encouraged the more pretentious venture at Elk Rapids, and late reports from the latter furnace place it in the front rank for economical fuel consumption and large output.

A number of retorts are scattered throughout the country. The Baltimore Iron Company have sixteen horizontal retorts, the Port Leyden Iron Company have twenty-four Mathieu retorts, and a number of iron works now have or are erecting the latter. The Mathieu retort has met with most favor, and at present is being more rapidly adopted than others, because of its form and setting, and on account of the inventor's making the quality of his charcoal the first claim, and the quantity of acetates collected a secondary consideration. The forms of retorts in use in this country are generally iron cylinders, set either horizontally in nests over fire places, or vertically with flues surrounded them. Departures from this plan are the retorts at Coloma, Michigan, where a semi cylindrical iron bottom is covered by a fire brick arch. these forming a complete cylinder, and the Missau still, in which the carbonization is carried on by the use of superheated steam. This, however, is principally employed with resinous woods.

The Baltimore Iron Company report as the average yield of the horizontal retorts fifty bushels per cord. The Port Leyden Iron Company have been obtaining sixty-six bushels per cord. Part of this difference may be accounted for by the age and character of the wood used, but it is probable that a less uniform carbonization in the horizontal cylinders is obtained than in the Mathieu retorts.

These latter are made nearly crescent shape to give a practically uniform thickness of wood, and are set inclined over fire places. This method of setting is advantageous on account of the convenience of filling and discharging, and of its permitting any condensed acid to drain from the retorts when cold, thus preserving the life of the retorts. It is claimed that while in operation there is little danger of the iron in the retorts being attacked by acetic acid, because the heat maintainev is sufficient for volatilization. Some two hundred of the Mathieu retorts are in place or in process of erection at various works located in different sections of the country. They are constructed of a bottom plate of one-half inch wrought iron, which is protected by an arch of fire brick, the upper portion being formed of one-eighth inch wrought iron connected to the bottom by angle irons. A suitable cast-iron head, with removable door, is placed on either end, to which a nozzle for conveying the vapors from the retort is secured. Each retort is about fourteen feet long. The capacity is one cord of wood ordinarily cut sixteen inches long. With air dried wood, as

* A paper read before the American Institution of Civil Engineers.