SECTION THIRD.

Grain used in the distilling at Toronto; of distillers in general; Fermentation; of sugar and alcohol generally; Stills and Refrigerators described: Improvements of the Still by Edouard Adam; The Still in operation: Rectifying rooms, uses of chacoal; Structure of the distillery; the men who built it.

The grains used by the firm of Gooderham & Worts are barley malted, barley raw, rye, oats and Indian corn. The latter and most of the rye are brought from Chicago either by ship through Michigan lake, Huron lake, river St. Clair, river Detroit, Erie lake and Welland canal to Lake Ontario, or by the more direct route through Lake Huron and Georgian Bay, thence to Toronto by Northern Railroad. The barley and oats are obtained in Toronto market, and annually about 15,000 bushels of the rye.

In converting barley to malt it germinates by steeping in water, and is then dried by artificial heat. In its germination, a peculiar substance is generated in the grain called diastase, which acts chemically on the starch of the grain, converting it first into a kind of gum called dextrine, and then into a sweet substance identical in composition with grape sugar. It has been found that this diastase can convert 2,000 parts of starch into grape sugar; and it is of this valuable property that the distiller avails himself when he adds malt to his raw grain. To save the more expensive article malt he uses only so much as experiment has proved will suffice to change the starch of the raw grain into sugar when mixed with it in the mash tub. The distiller therefore, to prepare the saccharine matter for his operations has to go through all the processes of brewing before he gets it ready for the still.

By the Excise Laws in Britain mashing or fermenting, and distillation of the fermented product are not, or recently were not allowed to be carried on in the same building on the same days. In the largest distilleries in Scotland and Ireland the mashes are made and fermenting processes carried through every Thursday, Friday, and Saturday, while the fermented wash is distilled on every Monday, Tuesday, and Wednesday. At Toronto the processes go on one with the other without intermission.

Fermentation is carried so far (in distilleries generally) as to reduce the wash or 'beer' to the specific gravity of water, that is 1,000. When the wash is made from molasses or sugar it is often reduced below that gravity, but rarely when made from a mixture of raw grains. Even by this great attenuation it is not thereby converted into alcohol, as it increases in the wash, gradually arrests the decomposition of the sugar and at length stops it altogether. It is the presence of this large quantity of undecomposed sugar in the spent wash, from which the spirit has been distilled, which gives it the sweet taste so relishable to cows, so valuable to the dairyman, so generous to the consumers of milk. The whole quantity, however, which escapes decomposition or conversion into alcohol is a loss to the distiller. In the manufacture of Hollands and of Rum, a considerable saving is effected by refermenting the spent wash, or by using it for mashing a fresh quantity of grain.

The still is a chemical apparatus employed for the purpose of separating the more volatile from the less volatile fluids. In that before us it rises forty feet high through two floors. A lower portion of the tall, upright frame work is seen on the right hand corner of the illustration, No. 8.

It is connected with a tub termed a Refrigerator, in which the volatile vapor raised from the fluid in the Still is condensed, and drops or distils into a vessel called the Receiver. The Refrigerator is the large Worm tub seen in the same picture; 12 feet high; 14 feet wide at bottom.

The still has a high head to prevent the fluid from boiling over. To this head a tube is connected ten inches diameter at top, which is carried in a spiral form, winding twice round in the interior of that Worm tub 700 feet if extended in length. It contracts to three inches at the end, discharging into the receivers. From its twisted form the tube is called the 'Worm.' The Worm tub being filled with cold water, the alcoholic vapor within the twisted tube cools, is condensed in cooling to a fluid, and runs into the receiver. The spent wash issues from six spouts, of which three are seen in illustration No. 8, runs through conductors out of the building under Trinity street, still warm and steaming, and is forced up to the tank sufficiently high to admit of barrel carts being filled underneath.

The spirit issues out in a bubbling spring, within a crystal cover; the metal work of the piping all burnished copper, fashioned by hammer, not cast, made as the other copper work was, by Booth and Son, of Toronto, all of workmanship, excellent, beautiful, perfect. That bubbling spring passes from 280 to 300 gallons of spirit per hour, according to the strength. The three elevated circular vessels, seen in perspective beyond the great Refrigerator are receivers filled from the rectifying rooms, on the next two floors overhead. One of the rectifying rooms is shown in illustration No. 9. The man with the barrel at one of the receivers is 'racking off' the spirit for the store or for shipment to market. The barrels are lowered from this to the floor below, where the 'racking off' is principally performed. It is done at different places, because of the varying strength and quality required for different markets. Indicating weights are suspended outside of these receivers to notify when they are full, or how far from full.—They contain each 4,000 gallons.

The stills, one of which is seen in the picture of this room, (illustration No. 8,) rise up to the top of the building forty feet high, through the next two floors. They are capable of running the wash or 'beer' of seventy bushels per hour. I will here endeavor to convey an explanation of what a still is:

By the old stills such a quantity of watery vapor was carried over along with the alcohol that the distilled spirit had to be subjected to a second process, termed 'doubling,' before it could be made of the proper legal strength. One of the greatest modern improvements therefore, in this art, was the invention of a still which accomplished this object at one operation.

This was effected by a workman in France named Edouard Adam, an illiterate person employed in a distillery, but with the genius of applicability lying largely within him.—Hearing a chemical lecture on the contrivance known to chemists as the apparatus of Woulfe, he applied the principle to the condensation of the vapor of alcohol. By causing the hot vapors to chase the alcohol from chamber to chamber, Adam obtained in the successive chambers alcohol of any strength and purity. Since his time that still has received various improvements.

The principle which has guided the improvements is founded on the fact that the boiling point of alcohol varies with its density or strength. The purer it is it requires the less heat to raise it into the state of vapor, and the more it is diluted with water the greater is the heat required to distil it.—Thus, alcohol of the specific gravity of .793 boils at about 168 degrees, that of strength .851 boils at 179 degrees, and that of .912 specific gravity boils at 197 degrees.

In the still the wash is never exposed to the direct heat of the fire, but is exposed (in a series of shallow chambers placed one over the other) to the vapor of steam, which rises through the perforated bottoms of each chamber and carries off the alcoholic vapors into the condenser. This condenser also consists of a series of chambers separated from each other by perforated plates and is so contrived that the cold wash passing in pipes through these chambers, in its way to feed the other series of chambers, acts as the condenser to the vapor of the alcohol. the wash being gradually heated thereby as it passes through the successive chambers. The still, therefore, consists essentially of three separate but connected parts, namely: 1st, of a large square receiver at the base, which receives the spent wash after it has been deprived of its alcohol by passing through the series of evaporating chambers. That we have noticed in figure No. 8. 2d, of a large square upright box termed 'analyzer,' containing the series of evaporating chambers, each communicating with the one below by means of a valved tube, which only allows fluid to escape from the upper to the lower chamber, and having the dividing partition of each chamber perforated with fine apertures, to allow the steam which is admitted from below to pass from chamber to chamber through the shallow layer of wash in each.

A safety or escape valve is also fitted to each chamber. The already heated wash enters the uppermost of these in a continuous regulated stream. We see the beginning of this when aloft in the highest floor. There a circular tank receives it as pumped from below, and feeds the still. It is gradually deprived of its alcohol by the steam as it passes from chamber to chamber, and at last escapes into the lower large receiver from which it flows off after attaining a certain depth.

The third part of the operators consists also of a square upright box, termed 'Condenser,' divided into compartments by means of finely-perforated plates, and in each chamber is a link of the tube which carries the cold wash outwards to supply the evaporating chambers just described. The alcoholic vapors escaping from the uppermost of the evaporating chambers are carried by pipes to the lowermost, and are partly condensed by each successive chamber being colder than the one below it, in consequence of the wash entering the pipes from above, and only getting gradually heated by contact with the alcoholic vapor as it advances from chamber to chamber.

As in the lowest of these chambers the heat is greatest, the alcoholic vapor or the condensed spirit contains a larger amount of water; but as the chambers are successively cooler, the alcoholic vapor and condensed spirit at last arrive at a temperature only sufficient to convert spirit of the strength wished into vapor, and by an adaptation of valves and substituting an impervious partition for the perforated plate; and admitting the alcoholic vapor into the chambers cooled by the passage of the contained wash in its contained pipes, that spirituous vapor is condensed, and the spirit is drawn off at one operation of the very strength which it ought to have, and of the utmost purity.

Having traced the process of distillation, let us descend to the ground floor of the western half of the main building, to another machinery room (illustration No. 5.) Behind the central division wall forming the east end of this spacious area is the steam engine (illustration No. 2) before noticed, and beyond that, behind another wall in the machinery room (illustration No. 3.) In this No. 5, is a vertical shaft receiving motion from the engine behind the wall, and distributing motion upward to the highest floor of the house, and downward by vertical shaft, cog wheel and two pinions to a horizontal shaft crossing the room, and at each angle of that are cog wheels and pinions continuing the motion to horizontal shafts lying longitudinally, and working a series of pumps; two pumps are raising water from the lake to the tank, as seen on north outside of the building, and to filterers to supply the rectifyers and other places where required. Another pump is raising the 'beer,' which has come under the ground floor from the fermenting cellars (No. 7) and giving it to the still through the vat on the fifth floor as already told. Here are four vertical shafts driving the rotatory agitators in the mashing tubs on the floor overhead. Here too is a fire engine with steam always up and hose laid throuuh every apartment on the premises. To make sure that the fire engine would not be out of order were it unfortunately needed, it is required to give assistance in some of the industry of this room to keep itself in working order. As to what particular part the fire engine performs my note book leaves me in doubt. For here, it may be remarked, I had not seen the distillery nor any one connected with it, nor had I heard it described before noon on Tuesday 21st instant. I have had to become acquainted with all the matters related in this supplement and assort it to the wood cuts by Thursday evening, in addition to what the reader may find from the same pen on other pages of this paper. This is not named as a matter to 'blow' about, on the contrary, it is a circumstance to be sorry for, as one can hardly give a finished literary sketch when obliged to learn as he goes along the lesson he is rehearsing. Mr. D. D. Robertson, of Hamilton, made the sketches which are both accurate and picturesque. They were engraved by the artists on the staff of this journal. It is now for the people of Canada to extend their patronage, and the engravers will forthwith give to the world a first class Illustrated Newspaper, as one of the native products of this Province.

On my arrival at the distillery on Tuesday at noon, two hours were lost to me while the Superintendent, Mr. Gooderham, junior, attended on a more potent and imperative personage—the Government Excise Officer.—This room (illustration No. 5,) is the theatre of his fiscal operations; 15 cents on the gallon of distilled spirits; $150,000 per annum to the Government. Two large tubs, holding each between 7000 and 8000 gallons, each ten feet high, and twelve feet diameter at the bottom, stand up side by side. Between them is a guage indicating the quantity of spirits at any time held in either. They are connected by a pipe from the still, and from themselves to the rectifyers. Their contents is in that intermediate condition of manufacture termed 'high wines.' A stop-cock in the connecting pipe has a lever handle attached which the Officer of Excise fastens with a padlock when he has taken the guage of the one that may in his absence be emptied, and the other may be filled, but nothing more.

We may now quit distillation, and take note of the process of rectifying. On the third floor, as seen in the front view of the main building, is the first rectifying room (illustration No. 9). There are 42 rectifiers in this and a room on the fourth floor overhead; each eighty feet high, six feet diameter at top, five feet at bottom; and each holding 200 bushels of charcoal. The spirit is filtered through that substance. The charcoal is renewed entirely four times a year, but is partially changed at intermediate intervals. It is made from maple, and is purchased in Buffalo, none being manufactured in Canada anywhere convenient to Toronto. The 42 vats rectify all that is run from the still, about 6000 gallons daily.

When drawn off from the rectifiers the spirituous fluid is only 'common whisky.' It is stored, and ripens for the market in from two to twelve months. The higher qualities of spirit, as 'old rye,' or 'toddy whisky,' are not much in request in Upper Canada; there the 'common' prevails. But in Lower Canada the 'common' is rejected, and the higher qualities only purchased. 'Common,' though paying 15 cents a gallon of duty, is sold wholesale for 20 cents.

To produce 'old rye' and 'toddy whisky' the old windmill plays its part. It is fitted up with two copper stills whose capacity is 1,500 gallons each. There steam is set on and the fluid is brought to the highest point of strength, separating as before, but in greater quantity all deleterious matter in the shape of oils, while the spirit going off in steam, is again condensed by the worm and thence emanates in purest quality. It is now 60 over proof by Sykes' hydrometer, or 96 American over proof. Besides to Lower Canada, large quantities of this quality have been shipped to Liverpool and London, where it is much approved. By reducing its strength with a mixture of distilled water, that is, water absolutely pure, derived from steam—the 'toddy' and 'old rye' are produced. 'Those articles, says an authority better qualified to judge than I, 'are unquestionably the best and purest that can be manufactured from grain, and it would be an improvement if they could take the place of all the 'common' whisky which is consumed throughout Upper Canada.'

Throughout the great establisbment every possible care is taken to have the article kept in the most healthy state, and every room, pipe and fixture in the entire edifice is as clean and free from impurity as the most scrupulous house-wife could desire. Nothing which could save labor and avoid danger and render effective every advantage which nature and art affords has been spared; from the engine to the tiniest tap, everything is a model of completeness and efficiency.

The structure of the distillery, its strength and the admirable arrangement of its parts bear witness to the practical ability as common fame proclaims the high reputation of Mr. Roberts, the architect and engineer.—From making plans and specifications, and obtaining a solid foundation in 1859, until all was complete, he was ever present, ever vigilant; and the proprietors endorse his praises. The stone was obtained from a quarry five miles below Kingston. It is the stratified limestone so abundantly found in that vicinity. Mr. Gooderham selected it at the quarries himself. The walls are three feet thick. The massive transverse beams are laid in pairs side by side, the iron columns supporting the machinery floors running from basement to top floors in continuous shafts of prodigious strength, twelve inches in diameter. The horizontal beams of timber are doubled, in order that if one decays it may be taken out and replaced by another without the solidity of the fabric being put in jeopardity. To render that practicable the ends of the beams rest on 'coble stones,' projections made from the wall to form their bed. Their ends will, by that precaution, be protected from liability to rot.

The frame work of the roof is in itself a monument to the architect, but cannot be explained within the limited space into which my closing remarks are being crowded. The builders were Godson & Kesteven, but the masonry was in part done by the proprietors. The woodwork was done by Messrs. Smith & Burke, of whom the proprietors continue to speak in terms of approval. The millstones and machinery came from Mr. James Good, of Yonge street, Toronto. The copper work, so beautiful and substantial, came from the hands of Messrs. Booth & Son, of Toronto, as already told.

Forty-five barrels, holding each 53 gallons of whisky; or 21 puncheons of 125 gallons to the puncheon, are one car load. At present 2,000 puncheons and 5,000 barrels are out, which are likely to be returned when empty.

Such is the establishment of Messrs. Gooderham & Worts, which cost $150,000 in construction, and pays a like sum annually as a tax to Government. A. SOMERVILLE.