Experiments of Candle Wicks; and on the effects of Chlorine upon the combustible properties of the Wax of the Candleberry Myrtle. By Mr. JOHN REID, Member of the South African Institution.

[*Read at the South African Institution.*]

THE fat of the Sheep or the Cow when exposed to the temperature of 120° of Fahrenheit melts, and when exposed to the temperature of 500° suffers decompesition, and is converted into gaseous compounds consisting of Carbon, Hydrogen, and Oxygen. At this elevated temperature they burn in contact with atmospheric Air, the combination being attended with the extrication of Caloric and Light.

When a Candle is lighted a portion of Tallow is melted, is attracted by the Wick till it is brought within reach of the flame, where it is converted into the compounds abovementioned, which combining with the Oxygen of the Atmosphere give out Caloric and Light. This Caloric melts another portion of Tallow, which is attracted, decomposed, and undergoes combustion, and thus is a regular supply kept up.

Combustion requires an elevated temperature; if therefore any substance at a low temperature is brought near the flame, it abstracts a portion of Caloric, and causes a diminution of its size, and if brought still more close, or a substance at a lower temperature is made to approach it equally near, it is entirely extinguished.

These circumstances serve the important purpose of regulating the combustion, for if this communication of Caloric to surrounding objects did not take place, and if the combination was effected at a low temperature, the whole mass would suffer almost instantaneous conflagration. When a Candle is lighted or relighted, the Wick either having no Tallow or only a small quantity, is soon consumed, and the flame is forced to descend till it comes near the mass of unmelted matter; in this case, or when the Wick is snuffed too close, the Caloric being abstracted too rapidly, the flame is diminished in size; and on account of its proximity to the mass, melts a greater quantity of Tallow than is required for the proper supply, which accumulates and makes the Candle gutter, causing waste and inconvenience. On the other hand, when a Candle has burnt for some time, the Wick becomes too long, diminishing by its presence the quantity of light evolved by the combustion. This obscuration may be partly owing to the shadow of this opaque body, but is in part owing also to the influence it exerts upon the chemical process which takes place. As the Wick is not consumed, it requires a constant supply of Caloric to keep it at an elevated temperature, which being abstracted

from the combustible compounds lowers their temperature, renders the combustion less complete, and produces a yellow flame instead of the usual white flame which diffuses more light. In consequence of this imperfect combustion, a portion of carbon is deposited, which either passes off in the form of smoke, or adheres to the Wick increasing its size. It is therefore of importance that the Wick should be of a proper length, that it may on the one hand afford sufficient surface upon which combustion may take place, and on the other not diminish more than is necessary the effect of the light which the combustion renders sensible.

The thickness of the Wick is of importance as well as its length. When not sufficiently thick it is apt to incline downwards and fall upon the Candle; or if it remain upright it does not attract a sufficient supply of melted Tallow for the combustion: when it is too thick, though a sufficient quantity of melted Tallow may be attracted and consumed, the illuminating effect is diminished in the same way as when it is too long, the diminution being greater in proportion to its size. To remedy this it was suggested to me to try the effect of a flat Wick; accordingly I made a Candle with a Wick consisting of three separate Cords placed in a plane with each other, the breadth of which consequently exceeded its thickness; I also made another Candle with two Wicks placed at a distance from each other, each Wick containing five threads; a third with three Wicks each, containing five threads; and a fourth with one round Wick, containing twenty threads, and compared the illuminating effect of each with that of a common Wax Candle. The manner in which the experiment was made was the following: two square boxes were procured, each having one side open, the top and bottom being closed, these were placed with the open sides facing a wall; in one I placed the Wax Candle, in the other box each of the other Candles successively, and between the two boxes a cylindrical object at the distance of four inches from the wall. Both Candles being lighted and snuffed so as to have the Wicks of the length best adapted for giving the maximum of light. Keeping the Wax Candle at the distance of 18 inches from the wall, the others were moved backwards or forwards according to circumstances, so as to obtain a shadow of equal intensity from each Candle. The following are the results which I obtained, but which considering that the flame of a Candle is at all times variable, can only be looked upon as approximations to the average effect. As the number 18 indicates the distance in inches at which the Wax Candle was placed from the wall, so the number opposite each of the other Candles shows the distance at which they severally produced a light equal to that from the Wax Candle.

Common Wax, - - - - - - - - - - - - - - 18
Tallow with flat Wick composed of three Cords,
each containing 5 threads, - - - - - - - - 17
Tallow with one Wick, containing 20 threads, - 15
Tallow with two Wicks, each containing 5 threads, 18
Tallow with three Wicks, each containing 5 threads, $26\frac{1}{2}$

It has been ascertained by experiment, that the luminous effect is increased or diminished in proportion to the square of the distance; therefore, if one body produces the same effect at the distance of sixteen inches as another at twelve inches, the illuminating power is as nine to sixteen. This principle enables us to find out the comparative quantity of light emitted from each of these Candles. But for our present purpose it is sufficient to say, that the Candle with three Wicks, containing in all fifteen threads, produces in burning the same effect at the distance of $26\frac{1}{2}$ inches as that with two Wicks, containing in both ten threads at the distance of 18 inches, and the same as that with one Wick, containing twenty threads at the distance of 15 inches, and so with regard to the others.

In endeavouring to ascertain the effect produced by diminishing the size of the Wick, using as before a Wax Candle as the standard, I obtained the following results:

Wax, - - - - - - - - - - - - - - - 18
Tallow with three Wicks, each containing 5 threads, $16\frac{1}{2}$
Ditto, ditto, ditto, 4 threads, $23\frac{3}{4}$
Ditto, ditto, ditto, 3 threads, $21\frac{1}{2}$

A circumstance which influences the illuminating effect, is the distance at which the Wicks are apart from each other, as it increases till they are at the distance of a quarter of an inch, beyond which when five threads compose the Wick, two flames are formed, but does not materially diminish at a distance of one-third of an inch, when the flames are completety separate. The most eligible distance would be a quarter of an inch, but as in burning they sometimes vary their position, approaching to or receding from each other, the distance of one-sixth of an inch is to be preferred at which we may always obtain one flame from both.

On endeavouring to ascertain the comparative quantity of light evolved from a given quantity of Tallow, using a common Tallow Candle and one with two Wicks, I found that when both are kept snuffed closely, there is but little difference; in one experiment the quantity of Tallow consumed in half an hour, care being taken during the time to keep the flame in each equal, being of the

Common Tallow Candle, - - - 68 grs.
Candle with two Wicks, - - - 66 grs.

In another experiment the quantity consumed was the same

in each. In another experiment I allowed both Candles to burn without snuffing them, till the Wick attained the length of an inch, in which state the consumption of Tallow is not much different to that which takes place when they are kept of a moderate length. The result I obtained was as follows:

	inches.
Wax Candle as before, - - - - - - - - - -	18
Tallow with two Wicks, each containing 8 threads,	
when kept snuffed, - - - - - - - - - - -	21½
allowing it to remain unsnuffed, - - - - -	19½
Common tallow Candle with one Wick, containing	
20 threads, when kept snuffed, - - - - -	15
allowing it to remain unsnuffed, - - - - -	7½

As these observations shew that a Candle with two Wicks gives a light nearly equal to that of a Wax Candle, I shall endeavour to point out some of those circumstances which require attention in attempting to make it available for useful purposes. When each thread is not twisted separately, but the different threads are twisted together, each Wick in burning constantly changes its position, as occurs frequently in a Spermaceti or Wax Candle, where the end of the Wick points sometimes in one direction, sometimes in another, therefore the two Wicks at one time recede from and at another approach towards each other, or bend on different sides laterally; but when each thread is twisted separately and the whole are then twisted together, strength is given to the Wick, and it remains more steadily in one position.

A certain number of threads is necessary for giving that strength which is required to keep the Wick from bending. Though a sufficient degree of light may be obtained from two Wicks, each consisting of six or even three or four threads, such Wicks becoming during the combustion soaked with melted Tallow, and the top becoming loaded with a deposit of Carbon soon bend, and the rays of Caloric being directed too much upon the Candle melt the Tallow too fast, causing it to waste. The Wick therefore requires not less than 8 threads, the strength of which is sufficient to keep it upright till it reach the required length, when it bends and the extremity is gradually burnt off.*

The extremity of the Wick of a common Tallow Candle in burning, continues in the centre of the flame beyond the proper time, and receives such a deposit of Carbon as to increase its size greatly, and hence the light becomes diminished at least one-half. This has been obviated in some measure by placing the Candle in a position inclining from

* The Cotton which I used was that sold in the shops for making the best mould Tallow Candles; 8 threads form a Wick about the thickness of that of a common Wax Candle.

the perpendicular. But as the angle of inclination necessary to obviate the inconvenience is not less than 30° the suggestion has been seldom adopted. One principal object I had in view in making the experiment now detailed, was to form a Tallow Candle so, that this advantage might be obtained more readily. As a Tallow Candle with two Wicks gives nearly the same light as a Wax Candle, it seems better fitted for accomplishing this end than one with three Wicks; it was with it therefore that my observations were made. I found that when placed exactly upright, sometimes the Wicks either did not bend sufficiently soon, or inclined in opposite directions with regard to each other, and assumed a shape which was unpleasant to the eye. It seemed necessary on that account to give the Candle a position somewhat inclined, and I found that an angle of not more than ten degrees was sufficient, the wicks being placed in a plane with each other, and I generally in lighting the Candle gave it first a slight bend. With these arrangements I partially succeeded, such a Candle placed in this manner, burning without requiring snuffing, and the Wicks when consisting of 8 or 10 threads possessing sufficient strength to retain a straight form till they acquire sufficient length, when the extremity bends and is consumed. More extensive and varied observations than I have been able to make are necessary to ascertain the comparative advantages and disadvantages which such a Tallow Candle possesses, compared with a common Tallow Candle, so as to render it fit or unfit for use under peculiar circumstances. I apprehend, however, that though it may answer perfectly well when used in cold and temperate weather, and when there is no wind to affect the direction of the flame; in hot weather or when the atmosphere is not still, it will be found apt to gutter; for, on account of circumstances which further investigations are required to explain satisfactorily, Tallow is very liable, particularly in warm weather, to melt in too large quantity at the surface and to run down the sides of the Candle.

The Wax procured from the Candleberry Myrtle, of which there are several species indigenous in this Colony, and from which a large quantity is collected by the Farmers, is frequently used for making Candles. This Wax possesses a pleasant smell, and burns without emitting that unpleasant empyreumatic odour which renders the combustion of animal fat disagreeable. It is naturally white, but acquires in the process of manufacturing it, a deep green color derived from the soluble coloring matter of the seeds. It is much harder than Bees' Wax; is brittle and sonorous. Moistened with water and exposed to the action of the sun's rays, it very slowly loses its green color; in the course of six weeks becoming grey; but I apprehend such exposure however long

continued does not render it entirely white. It melts at the temperature of 107° of Fahrenheit, and at a temperature not much higher than 212° becomes so far decomposed as to assume a brown color. It burns with a bluish flame giving comparatively a faint light, and Candles made of it, in burning are even more apt than tallow Candles to run. Mixed with an equal quantity of Tallow, it forms a Candle which differs but little in its combustible properties from a Tallow Candle.

In endeavouring to ascertain the comparative illuminating properties of Berry Wax, and using the same Wax Candle as the standard, I obtained the following results:

Common Wax, - - - - - - - - - - - - - -	18
Berry Wax with one Wick, containing 20 threads,	13½
Berry Wax and Tallow in equal proportions, with one Wick, containing 20 threads, - - - - -	15

Berry Wax absorbs Chlorine Gas, three ounces of the Wax absorbing 16 oz. of Gas by measure: in consequence of this action it becomes white, increases in hardness and brittleness. It melts at the same temperature as the unbleached Wax, that is 107°. Melted over Water a substance separates from the mass; this substance absorbing water, increases in specific gravity and sinks to the bottom of the Wax in the form of a spongy mass. A small quantity of water remains diffused in minute globules through the mass of the Wax, and may be driven off by exposing it in a shallow vessel to the temperature of boiling water. In conducting this part of the process, care must be taken not to increase the heat beyond this point, otherwise it acquires a disagreeable brown colour. Upon cooling, it contracts very considerably, and thus is well fitted for taking very delicate impressions.

Berry Wax thus bleached burns with a clear flame, but requires a Wick nearly as thick as that of a Tallow Candle. It is not apt to gutter, on the contrary it does not generally melt faster than is necessary for carrying on the combustion. Hence it is well fitted for burning with two or three Wicks, and a Candle made in this manner gently inclined in the way formerly mentioned, may be used without being snuffed. The comparative trial afforded the following results:

Bees' Wax, - - - - - - - - - - - - - - -	18
Bleached Berry Wax, with one Wick, containing 20 threads, - - - - - - - - - - - - - - -	15
Bleached Berry Wax, with two Wicks, containing 8 threads, - - - - - - - - - - - - - - -	22

Results corresponding almost entirely with those from Tallow.

Thus it appears, that the chief advantages of the bleached Berry Wax are its greater cleanliness; being less apt to soil any thing which it touches; its want of unpleasant smell, and

its not being liable to gutter. How far these advantages may avail to render it deserving of being used as a preferable substitute for Tallow, I will not pretend at present to say; but if, as I am inclined to expect, the Chloride of Lime is found fitted for the purpose, I think it probable that it may be found to deserve a preference in many cases.

I may mention that the manner in which the Candles with two wicks were made, was as follows: I got a straight tube of tin, to one end of which I fitted a stopper of wood, having two holes at the proper distance apart. Through one of these holes I passed the end of the Wick from without, inwards, and carried it through the other hole from within, outwards, fastening this end on the outside with a pin which fitted the hole. I then passed a wire, having a hook at the end, through the tube, laid hold of the Wick, and drew it to the other end, where I fastened it with a piece of wood of such thickness as to keep the Wicks at the proper distance from each other, and fastened the other extremity of the Wick with another pin passed through the stopper. It is now ready for the reception of the melted matter, which is poured in in the usual way. This arrangement has this advantage, that the Candle may be drawn out sooner than it can be done in the usual way, in which if any considerable force is used, the Wick is liable to break, an inconvenience which is avoided by pushing in the stopper, after having taken out the pins, the Candle being thus forced upwards is loosened from its fastenings, and may then be more readily withdrawn entirely.

I am indebted for the following Botanical account of the Candleberry Myrtle, to the kindness of Mr. Bowie.

Candleberry Myrtle.

NATURAL ORDER. Amentaceæ. Jassieu. 407.
Sub-order 5. Myriceæ. Kunth. Synopsis. 1. p. 361.
Sexual System of Linnæus. Dioecia Tetrandria.
Genus. Myrica.

Generic. char. *Amentum*, oblong, scales of the *calyx*, ovate. Female Flower with two *styles; Drupa* one, seeded.

Sp. 1. M. æthiopica. African.
Upper leaves elliptic, partially toothed: lower leaves entire.

2. M. serrata. Saw leaved.
Leaves, lanceolate, unequally, but sharply serrate, younger branches somewhat hairy.

3. M. laciniata. Smooth, Oak-leaved.
Leaves, oblong-linear, deeply cut; younger branches with a resinous exudation.

4. M. QUERCIFOLIA. Hairy Oak-leaved.
Leaves, oblong, bluntly notched, younger branches downy.

5. M. CORDIFOLIA, Heart leaved.
Leaves somewhat heart-shaped, serrated, sessile, and partially imbricated.

N.B. Nos. 2, 3, and 4, are the species which produce the most Wax, and are generally found in sandy fields.

Nos. 1 and 5, are found midway up the Cape Mountains, and not unfrequently on the lower regions also with the other species.

There are three other species met with in the colony, though by some Botanists they are only considered as varieties of the former.

Notes on the Culture of the Vine, and on the Making of Wine. By DANIEL CLOETE, Esq. Member of the South African Institution.

Communicated by the Wine Committee.*

1. THE mode pursued in the culture of the Vine in this colony, is perhaps better calculated for the exposed situations of most of the vineyards, and the violent storms of wind to which we are subject, than the system of training the vines on espaliers, as at Madeira, by which there is, moreover, a manifest waste of labor, without any improvement in the quality of the grape, which certainly in this colony is not inferior to that of Madeira. How far manuring vineyards may be considered essential in this colony, I cannot venture an opinion, but it is not a custom pursued at Madeira, from an idea that it increases the quantity but affects the quality of the wines.

2. Greater attention ought, in this colony, to be paid to the selection of grapes destined for the press, in order rather that wines of two qualities should be obtained, namely, a superior and inferior sort; than one mass of comparatively indifferent wine.

3. At Madeira, the grapes upon having obtained a proper degree of maturity, are cut and thrown into the receiving vessels for the purpose of being trodden, as long as any juice can be expressed from them, when the stalks and husks are collected

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* Along with Mr. CLOETE's communication is the following extract from the Minutes of a Meeting of the Committee, held on the 10th February, 1830, and signed FRANCIS COLLISON, Secretary:

"Resolved, That the members present are sensible of the value of Mr. CLOETE's Treatise to the Public, and that the Secretary be requested to convey the thanks of the Committee, for the communication.

"Resolved, That the same be forwarded to the South African Institution, for insertion in the Quarterly Journal."