Myrica caroliniensis—W. Bayberry bush. Candleberry Myrtle. *Myrte à Chandelle. Galé cirier.*

"Leaves wedge-oblong, coarsely toothed. Staminate aments lax. Scales acute. Berries globular, large."

A shrub, three or four feet high, bearing berries covered with a substance resembling wax or tallow, as is also the fruit of two other American species, the cerifera and the pennsylvanica, from which candles have been made: on this subject an article in the first volume of the Society's Transactions, compiled by a member, may be consulted. This species grows along the seaboard from the Gulph of St. Lawrance to Florida, keeping within the influence of the sea atmosphere. I am informed by one of our Vice-Presidents,* that it is found in the Gulph of St. Lawrence, as high up as Hare Island.

[End of the first part.]

On Length *and* Space, *by the Rev.* D. Wilkie.

Length of time, is the continuance of any sensation, and is perceived by all the senses. It is measurable only in one way, that is, time has only one dimension.

Length, properly so called, that is, extension, is first perceived and accurately measured by the sense of Touch only. It is roughly judged of by the eye, and perceived by

* Andrew Stuart, Esqr.

no other sense whatever. It is measurable in three ways; that is, has three dimensions,—length, breadth, and thickness. Bodies can be measured in these three respects.

1.—If one body is laid upon my finger, and I feel the impression from the tip of the finger to the middle, and if another is laid upon it, so that I feel the impression from the one end of the finger to the other; there is, then, a manifest difference between the two impressions. I know not in what this difference consists; but, to make known to my companions that I perceive a difference, I call the object from which I receive the former impression SHORT, or SHORTER, and that from which I receive the latter impression LONG, or LONGER. By applying the same objects to different parts of the body, corresponding impressions will be received. Thus, it will appear, that objects which are *short* in one case, are so in every case; and that those which are *long* in one case, are long always. A belief is thus induced, that nature is uniform in her operations; and we never doubt, that objects that seemed longer at one time, will be found so at another. By directing the eye to the two objects, different impressions are received through this sense; and after a multitude of trials, we learn to distinguish long from short objects by their different appearances. In some bodies, namely, sonorous ones, long from short ones, may be distinguished by the ear, in consequence of the different sounds which they emit when struck. This information is generally very indefinite, but it admits of considerable improvement by practice and study.

Thus, it appears that our ideas of length, imply merely the perception of a difference between the impressions made upon them by long and short objects. All we know of the

subject is, that long and short objects make different impressions upon the senses both of touch and sight. We feel that difference, but know nothing of the cause of it, nor is it at all necessary that we should. We invent the terms long and short, to make known to others the difference that we feel. We agree with them respecting the words thus proper to be employed for our mutual advantage.

2.—It does not appear that the senses of tasting and smelling, furnish us with any ideas of length; that is to say, they do not distinguish between long bodies from short ones. For, though a difference may be perceived between a long and a short substance, when placed within the mouth or within the nose, this difference is discovered solely by the sense of touch diffused over these parts, as over the rest of the body, and not in the least by the different tastes or smells afforded by these substances.—Nor does our perception of the presence of electric substances give us any information on this subject.

Thus, it appears that our knowledge of the properties of long and short objects, is first received, and principally acquired by touch, greatly promoted by the eye, and in some cases, slightly assisted by the ear; and that by no other senses whatever, is any information received on this subject.

3.—From comparing together more than two objects, we acquire the ideas of *long*, *lónger*, *longest*, and *short*, *shorter*, *shortest;* and the purpose of social converse requires, in all languages, the invention of terms corresponding to those ideas. The meaning of these terms, is settled by convention, and cannot be conveyed by logical definition. On meeting a stranger to these words, we must show him examples of the objects, before we can

communicate to him our impression, or, in other words, make him understand what we mean by the terms thus employed. The word EQUAL is explained in the same manner.

4.—As a long substance exceeds a short in some respects, or is greater than it, the frequent application of these terms, would at least require the use of another. It would be natural to ask, in what way does it exceed?—and in what respect is it greater? To answer this question, as well as to suit other purposes in discourse, the invention of the abstract term LENGTH would be found convenient.—In what does your rod exceed mine? In length.

The introduction of this general and abstract term, must have been long posterior to the use of the words long and short: A further refinement in language required the use of the corresponding abstract term—SHORTNESS. But this being resorted to on much fewer occasions, and for much less important purposes, would be introduced much later in the progress of language. For the word length is applied to all objects whether comparatively long or short: but shortness is only applied when deficiency in length is intended. The further wants of society, introduced into their discourse, the verbs—TO LENGTHEN and TO SHORTEN.

5.—To ascertain whether one object was longer or shorter than another, the method that would most obviously present itself to those who had distinct ideas of length, or of long and short, would be to apply the one object to the other. It would then be preceived either by touching them or looking at them, whether they were equal, and if not, which was longer, and how much it was longer. If the idea of the number two had been previously familiarised to the mind, then by applying the short one twice to the

longer, it would be perceived whether the one was equal to two of the other. If the mind had been familiarised to higher numbers it could, in like manner, be ascertained, whether the one contained three or four times the other, or contained it any number of times whatever. Thus, the idea of a MEASURE would be acquired, and its name required in conversation.

6.—The utility of a measure would be still more apparent, when the mind came to compare two immoveable objects, which could not be brought together, for the purpose of determining which was longer or shorter. The application to them both successively, of the measure, the one being longer than itself, though it appears to us a simple expedient, was undoubtedly the fruit of much reasoning in the infancy of human intellect, and must have been hailed as a beautiful and useful invention. It appears, however, to be known in the rudest states of society ; and may be considered as the common property of the species. It does not appear that the inferior animals ever attempt to measure, or determine the comparative length or size of objects in any other way, than by looking at them, and touching them, though they must have acquired these impressions first by touch, as well as ourselves ; yet, it is demonstrable that they judge much more frequently by the eye than by the other sense. We invariably consider it as a mark of extraordinary sagacity in an animal, when we see it turn over an object with its foot for the purpose of perceiving its size and form.

7.—When two things are severally equal to the measure employed we see intuitively, that they are equal to another. By contemplating a number of conclusions of this sort, we come to this general conclusion that, " things which are

" equal to the same thing, are equal to each other." This general truth, we call an AXIOM or FIRST TRUTH; because it is certain, and cannot be called in question. Yet its evidence arises entirely from the view of particular instances taken in detail; and not from any quality in the general proposition. This axiom is as applicable to numbers as to length, and its evidence there also arises from a view of particular instances. By the application of numbers to measures of length, we obtain another set of axioms. Thus, things which are severaly double of one thing, are equal. Things which are severally treble of one thing, are equal. Things which are halves of the same thing, are equal. These axioms are obviously innumerable, all undeniable, and of great utility.

8.—Material objects may be considered as longer and shorter, not only in regard to the distance of the one end from the other, but also in regard to the distance of one side from the other. For the sake of distinction, the former distance is called the LENGTH, properly so called, of the object, and the latter is termed its BREADTH. The two ideas are obtained in perfectly the same way from touch, improved in the same way by the sight, and perfected in the same way by an accurate measure—they admit of the same axioms. In fact, they differ in nothing except this single circumstance, that the one is the distance of the ends, the other of the sides. Whenever the length and breadth are unequal, the less is considered as the breadth, and the greater as the length. Mathematicians correct the loose ideas of mankind on this subject. But their definition of breadth pre-supposes that of a perpendicular, and previous even to that, the knowledge of the properties of a straight line, which cannot be defined.

9.—But further, material objects are found to be longer or shorter not only in their distance from end to end, and from side to side, but also from top to bottom, or from the upper surface to the lower. This introduces the idea of height, depth, or THICKNESS. Our ideas of this quality are obtained precisely in the same way as those of length and breadth, are improved in the same manner, and explained to others in the same way. The property itself is measured in the same way, and admits of a similar mathematical definition with breadth.

10.—Such are the three dimensions, or measurable properties of bodies, and they are not known to possess any others. Of these three, the primary is *length*. This is the first which the infant, or rude mind contemplates; and it is that which occurs most frequently in human life. Whatever measure, therefore is adopted for it, is used also for the other two. An accurate measure of it pre-supposes the knowledge of the properties of a line, and of a straight line, the exact meaning of both which terms, must be communicated by example and explanation, as no logical definition of them can be obtained. The measure of length is the foundation of all other measures whatever, of time, motion, weight, price, power, heat, electricity, moisture, &c. No accurate measure is known to exist which has not this for its foundation. Yet measures of length are adopted by the individual only by arbitrary assumption, and used by different individuals by convention or by imitation.

11.—Some objects have a sensible breadth in every part of them; others are so thin and narrow, that, to the untutored mind, they appear to have no breadth at all, and to possess only length. The former impression, when we would speak of it, comes to be denoted by the various

terms, SPACE, ROOM, EXTENT, SURFACE, SUPERFICIES. The meaning of these terms is usually explained to children, by showing that the room in which they are, contains more space than the table, the table more than the paper on which they write, the paper more than one's hand, and the hand more than the blade of a knife. It is no solid objection to this account, that the ideas thus furnished are inaccurate, and that we afterwards discover, by mathematical contemplation, that there are no material objects without breadth. This correction of our ideas is long posterior to the origin of them, and pre-supposes much experience in thinking and reasoning. We learn, then, after all this aid to think of those creatures of imagination called LINES, that is length without breadth or thickness, and inquire into their properties. We thus also acquire correct ideas of surface, and learn the art of measuring it. Neither let it be objected that, if nature did not give us the idea of a mathematical line, no effort of imagination could. This may probably be true. Children, and very ignorant persons, have nearly the same, probably the very same conception of a hair, a thread, a fibre, and other long thin substances, that a mathematician has of a line. Experience and reflection afterwards discover, that no body can be felt which has not sensible breadth and thickness; and the mathematician transfers to the creatures of his imagination, the properties which he had formerly, but erroneously, attributed to certain material objects. That is, he thinks certain things, namely lines, to be long and not broad; which is exactly the distinction made by inexperienced persons, between substances that have surface or breadth, and those that are thought to have none. The distinction between surfaces and solids, is rudely introduced, and

afterwards corrected, in precisely the same manner.

12.—It is evident that the idea of length, upon which all these which we are here concerned with depend, cannot be acquired without the assistance of memory. Without this power, the length of no objects can be compared, which do not present themselves to the senses at the same instant of time. Even when two objects are felt by the hand, or seen by the eye, at the same time, it is doubtful whether the mind attends to them both at once. It is more probable, that they are felt and seen successively; and that the mind attends first to the one and then to the other. Consequently the exercise of memory must be necessary even for the comparison of objects immediately perceived.

13.—When the mind has been well accustomed to the view of lines, and has actually felt and seen many of them; it will readily perceive that they are of different kinds. In viewing many different lines, or many different objects that possess length, memory will soon suggest to us, that these lines are not all of the same nature. Thus a rainbow, a coiled rope, and an arrow present appearances extremely different from one another. The impressions which the two latter produce upon the sense of touch are as different as those produced by them upon the sight. A number of trials, while memory compares the present with the past, convinces us, that the impression made by the coil of ropes upon the touch is uniform: and that that upon the sight is also uniform. The impressions made by the arrow upon the same sense are equally uniform. The effects arising from perceiving these two objects by either sense, are perfectly distinct; and, though we can never tell in which that difference consists, the difference is so striking, that so long as memory remains, we are never in any danger

of confounding those two objects. But it is not enough to perceive this difference. We wish to communicate our perceptions to others with whom we have already conversed on other subjects. We wish to tell some other persons which object it is we perceive, or which description of objects. For this purpose we apply the word STRAIGHT to the one, and the word ROUND to the other. When still greater precision of language was required, all lines which are not straight were called CURVES, and the word *round* appropriated to circular bodies, or circular lines.

Mathematicians have been at vast pains to discover an appropriate and logical definition of the word straight, but hitherto with very little success. Whether a logical definition of it may be obtained, I shall enquire afterwards. What I mean to state at present is, that mankind in general, learn the meaning of this term solely from exemplification. We teach children the distinction, by placing a straight and a curve object before them, and telling them that the one is named the one way, and the other the other way. It is certain that they all learn the distinction very quickly in this way, and understand very clearly what is meant by these two words. But if they were left to be taught the distinction by logical definition, millions must certainly remain for ever ignorant of it; and it is extremely doubtful, whether any could, ever by this means, become acquainted with it.

14.—The science of geometry is founded on our knowledge of lines. Before men can study geometry, they must be agreed about the meaning of certain terms which lie at the foundation of that science, but which do not admit of any logical definition. The following appear to be the principal terms used in geometry, which fall under this

description: Length, breadth, thickness; a body, a surface, a line, a point; a straight line, a curve, an angle. The meaning of these terms must be settled by description, and by exhibiting examples to the eye. When this is done, all the other terms used in geometry may be logically defined, so that their precise application can never be mistaken, nor admit of any ambiguity. But, besides determining by convention and example, the meaning of the abovementioned terms, it is further necessary, before proceeding to teach the science of geometry, to assume some property of a straight line. For this purpose, different properties of the straight line, have been assumed by different geometers. One of the properties most commonly assumed for this purpose is, that "if two straight lines coincide in two points, they will coincide throughout."—This property, though not assumed by Euclid, is implied in the fourth proposition of the first book; for, if it be not presupposed, the bases of the two triangles, though coinciding in the two angular points, may not coincide in other points, and consequently may not be equal. Another property sometimes employed for this purpose is, that a straight line is the shortest distance between two points.—But each of these is a theorem, and not a definition. They are indeed both theorems which cannot be demonstrated or proved, and therefore I have said, they must be assumed. What I have said of the impossibility of defining the terms straight line and angle, refers only to the present state of the science, and does not preclude the possibility of discovering definitions of one or both of them. A logical definition of an angle, would add a new beauty, and a new degree of simplicity to the subject; but a correctly logical definition of a straight line would greatly elucidate the elements of

the science, and remove the principal obstacles that lie in the way of the young student's advancement. Besides these assumptions, a new one has been usually found necessary to the illustration of parallel lines. Legendre is said to have removed the necessity of this assumption in two ways. —Leslie professes to have removed the difficulty, in prop. 23d, book I. of his Elements of Geometry, but has not entirely succeeded. If logical definitions could be found for a straight line and angle, which would lead to direct proofs of the different properties of these two objects, as well as of parallel lines; it appears to me, that the theory of geometry would be complete.— Our notions of length, breadth, thickness; of a body, a surface, a line; are derived from the senses, and cannot, in all probability, be derived from any other source.

Number is derived from all the senses, and is a property of all objects whatever, even of such as are incorporeal. Arithmetic is therefore the simplest of all sciences. The only terms which it requires to be understood without definition are, one, sum, difference. When the import of these terms is settled by convention, and by reference to the senses, all the others required, may be defined; and thus, the science is erected by the contemplations of the mind itself.

In this imperfect Essay, I have endeavoured to investigate,

1.—How ideas of length and shortness are introduced, and what we understand of these qualities, and the rise of the words denoting them.

2.—By what senses they are conveyed to us.

3.—How our language on this subject to further improvement.