

## CHAPTER VI.

*Best method of learning Technical terms—Organized and of inorganized Beings—The Root.*

106. WHEN you began to analyze plants, you were made acquainted with the first ten classes, because these are the most simple and easy to learn. But as you have now learned all the classes and orders, it is necessary that you should understand that the best method of analyzing a plant, is to begin by comparing it with the description of the last class, and if it does not belong there, to go on to the lower classes.

107. As you proceed in your Botanical studies, you will find it necessary to look out many words in the vocabulary, which is attached to the book you are now studying. In fact, the *language* of Botany is new to you, and you must make use of a dictionary, as if you were studying a new language.

108. It used to be considered necessary for a pupil in the first place to learn to repeat the hard words, or what are called the *technical terms*, but this was tedious and discouraging, and therefore Botany was thought to be a dry and difficult study.

109. But you can much better learn the technical terms by looking out their definitions as you have occasion to understand them; for instance, when you are examining some one plant, you find in the description of the species which belong to the genus to which you have traced it, one which is said to have leaves *radical*; by turning to the vocabulary, you find that this means growing from the root;\* if your plant has its leaves growing from the stalk, you will perceive that they were not radical. If the leaves were said to be *serrate*, by turning to the vocabulary, you find that this means having notches upon the edge, like the teeth of a saw (from *serra*, a saw;) if your plant has its leaves without such notches, you would see that they were not serrate. If the term *glabrous* were used, you would find it meant smooth; if the leaves of your plant were rough, you would see that this word would not apply to them. If another species was described as having

\* The root in Latin is *radix*, genitive *radicis*, from whence comes radical.

106. What is the best method of analyzing plants?  
 107. Why must you use a vocabulary in studying Botany?  
 108. Why was Botany formerly considered a dry study?  
 109. What is the best way of learning technical terms?

*cauline* leaves, (that is, growing out of the stem) *entire*, or without notches, *hirsute*, or rough, you would perceive that this description corresponded with your plant.

110. Now you will remember the words *radical* and *cauline*, *serrate* and *entire*, *glabrous* and *hirsute*, by learning them as you proceed in your analysis, much better than by committing them to memory with their definitions.

111. The exercise of looking out words in the vocabulary, and at the same time examining a plant, is useful, by bringing into exercise your judgment and powers of reasoning.

112. Thus you see, my dear children, how much more agreeable and profitable is the study of Botany now than formerly. Authors and teachers are labouring to make it easy and pleasant for you to learn. Many of the thorns and briars which once hindered the young from gaining access to the garden of knowledge, have been removed by those who love and care for you. And will you not put forth a little power to make your own way towards this delightful region, where rich fruits of literature and science will be the reward of your efforts?

113. The analysis of plants is called *Practical Botany*. We commence with this, because we think you will feel an interest in plants when you have become acquainted with their place in the system of Linnæus, and that you will wish to know the uses of their various organs, the manner in which they receive food, and what it is which makes them living beings.

114. These things will now be explained to you, and with attention on your part, you will be enabled to understand many curious and interesting facts. Every kind of plant which you can find, should be carefully examined, and each part noticed. Will not this be better for your minds than idle play? Your parents and teachers will delight to gratify your fondness for botanical walks, and will perhaps sometimes be at leisure to accompany you.

115. I have said plants are *living beings*. When deprived of water or air, they droop and die, as you would do without food and drink.

110. How would you be likely to remember the terms radical, cauline, &c.?  
 111. What effect does the analysis of plants have upon the mind?  
 112. What encouragements have children to endeavour to gain knowledge?  
 113. Why do we commence with Practical Botany?  
 114. What can you learn by giving your attention to these things?  
 115. Why do plants need water and air?



116. Plants are *organized* beings; that is, they are composed of parts which bear a mutual relation to each other; and which are all necessary to form a perfect individual.

117. Children, you too are organized beings; there is an intimate connexion between every part of your bodies. From your brain, a substance similar to it extends in every direction, forming nerves. If you prick your finger, or hurt your toe, the feeling which follows is communicated by nerves to your brain and by your brain to your mind.

118. If some organs of your body were topped off, for instance, your hands or feet, you would not be a perfect organized being; so if a plant were stripped of its leaves or deprived of its root, it would be an imperfect specimen of its kind.

119. But you might break a stone into many pieces, and each one would be as perfect a specimen of its kind as the whole stone was. This is because a stone is an *inorganized* being; that is, it does not consist of parts which have a mutual connexion and relation.

120. Plants, then, are living, organized beings; they are furnished with pores, by which they imbibe or suck their nourishment from surrounding bodies.

121. The principal organs of the plant are the Root, Stem, Leaves, and Flower.

122. The *Root* fixes the plant in the earth, and absorbs from it various substances necessary for its support.

123. The *Stem* conducts juices from the root to the leaves and branches; the divisions of the stem are *branches*; the divisions of these are *boughs*.

124. *Leaves* are to vegetables what lungs are to animals; by their means, the plant imbibes from the surrounding atmosphere, moisture, and a substance called *carbonic acid gas*; this is composed of two parts, oxygen and carbon; the latter is retained by the plant, and becomes a part of its own substance, while the oxygen, after being deprived of its carbon, is thrown back into the air.

116. Why are plants said to be organized beings?

117. Are there other organized beings besides plants?

118. When is an organized being imperfect?

119. Are stones organized beings?

120. How do plants derive nourishment from surrounding bodies?

121. What are the principal organs of the plant?

122. What is the use of the root?

123. What is the use of the stem?

124. What is the use of the leaves?

125. *Flower*. The parts of this have already been named. we shall speak more particularly of them hereafter.

126. The root, stem, and leaves, are organs necessary for the growth of the plant.

127. The flower contains within it the seed, and the parts necessary for its security and perfection.

#### Of the Root.

128. The root is that part which grows in the earth, and supports the plant in an upright position. It sends nourishment to every part. Some roots grow in water, and are called *aquatic*, (from *aqua*, water,)—some fix themselves upon other plants, and get their support from them,—these are called *parasites*.

129. The root gains its stock of food for the other parts of the plant by means of small tubes or fibres, which are called *radicles*, a word that signifies little roots.

#### Duration of Roots.

130. Roots, according to the age to which they live, are divided into three kinds; *annual*, *biennial*, and *perennial*.

131. *Annual roots* do not live over one year. They are raised from seed every season; this is usually sown in the spring; the plant comes up, bears its blossoms and fruit, and dies in autumn. Of this kind are poppies, beans, and cucumbers.

132. *Biennial roots* live two years. They do not blossom the first season; the next year they produce flowers and fruit, and the fruits die. You have probably seen cabbages carried into the cellar in the fall; the heads, which are only the leaves growing close together, are used for the table. The root, with the stalk upon it, is in the spring set out in the garden. Leaves soon spring from the stalk, these are used for sallad; by and by flowers appear, the petals of which drop off, and the germ becomes a pod or *siliqua* containing the seed. The root then dies, and no care can restore it to life. The life of the plant

125. Do you recollect the parts of the flower, as mentioned in Chapter 2d?

126. What are the organs necessary for the growth of the plant?

127. What does the flower contain?

128. What are the different kinds of root?

129. What are the radicles?

130. How are roots divided with respect to age?

131. What are annual roots?

132. What are biennial roots?



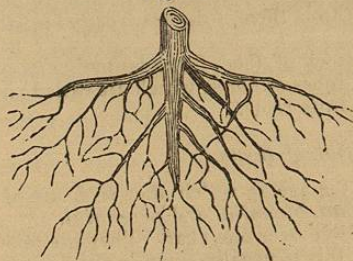
seems to be expended upon the blossom and fruit. The onion, beet, and carrot, are biennial plants.

133. *Perennial roots* live many years; among them are the asparagus, dandelion, and grasses, and all trees and woody plants.

134. Climate and cultivation affect the duration of the roots of vegetables. Some perennial plants become annual by transplanting them into cold climates: the garden nasturtion, a perennial shrub or woody plant of South America, has become in our latitude an annual plant.

#### Form of Roots.

Fig. 12.

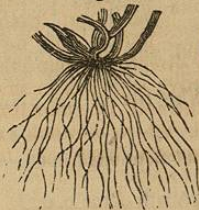


The shape of roots is different in different kinds of plants; the most common form is the

135. *Branching root*, which is divided into many parts, like the branches of a tree; some of these branches extend deep into the earth, while others creep along its surface.—Roots that have been torn up have been known to

become branches covered with leaves, and branches buried in the earth have become roots, and sent out fibres or radicles.—The radicles are the real roots, as they imbibe, through pores, the moisture and salts which the earth affords for the nourishment of the plant.

Fig. 13.



136. *Fibrous roots* consist almost wholly of radicles. Most of the annual plants, and also the grasses, have roots of this kind. The fibres usually grow directly from the bottom of the stem; by observing them in a handful of grass, you can understand the description, better than by any drawing.

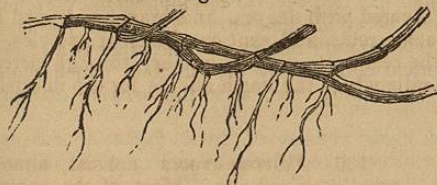
133. What are perennial roots?  
 134. What affect the duration of plant?  
 135. Describe branching roots.  
 136. Describe fibrous roots.

Fig. 14.



137. *Spindle roots* are large at the top, and tapering downwards, as carrots, radishes, &c.—This root has but few radicles, and is therefore not so well furnished with the means of gaining its food as some others. You could easily convince yourselves that the plant owes its food to these fibres, by taking two radishes, placing one in water until every part is covered except the radicles, and putting only the radicles of the other in water;—while the leaves of the former would soon droop and die, those of the latter would for some time remain fresh and green.

Fig. 15.



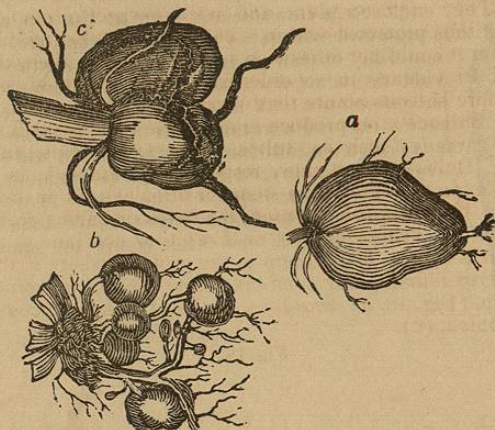
138. *Creeping roots*, instead of forcing their way downwards into the earth, extend almost horizontally along its surface; they send out many fibres, and new

plants spring forth from the roots in every direction around the original one. This kind of root is very hardy; it grows in sandy places, and is often useful in binding the soil, by spreading and weaving its fibres together. Holland, which is much exposed to the washing of its numerous lakes and bays, has its coasts bound together by such vegetable products.

137. Describe spindle roots.  
 138. What are creeping roots?



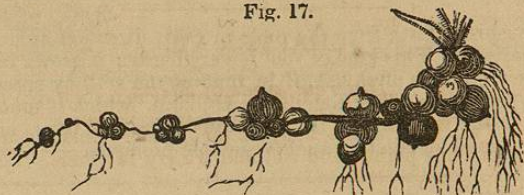
Fig. 16.



139. *Tuberous roots*, are hard, solid, and fleshy; they consist of knobs called *tubers*. Some have but one tuber, as the potato, which is shown at Fig. 16, *a*. In the artichoke, many tubers are strung together by fibres, as at *b*. In a kind of plants called *orchis*, the root has two tubers, resembling the parts into which a bean may be divided, as at *c*. You will perceive that they all are furnished with radicles. The tuber is a reservoir for the nourishment collected by the radicles. Such roots are *knobbed*, as in the potato; *oval*, as in the *orchis*; *abrupt*, as in the plantain.

140. *Granulated roots* consist of little *bulbs* or *tubers* strung together by a thread-like radicle, as in Fig. 17.

Fig. 17.



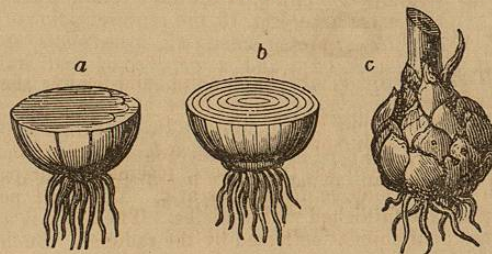
139. What are tuberous roots?

140. What are granulated roots?

141. *Bulbous roots* are fleshy, and of a bulbous or globular form. They enclose a plant, and in this respect resemble seeds. A plant thus protected within a bulb, is able to bear a degree of cold that it could not otherwise sustain. We see, then, the wisdom of Providence in so ordering things, that cold countries have more bulbous plants than warm ones.

142. Bulbous roots produce many of the most beautiful plants of our gardens; such as, tulips, lilies, snow-drops, and narcissi. Bulbs seem in many respects to resemble buds, and in some plants, they grow like stems or branches, as, in one kind of lily. In the *magical onion*, the bulbs or onions grow upon the stalk in clusters of four or five; they continue to enlarge until their weight brings them to the ground, where if they are suffered to remain, they soon take root. Bulbs are *solid*, as in the tulip, (Fig. 18, *a*) *scaly*, as in the lily, (*b*) and *coated*, as in the onion, (*c*).

Fig. 18.



143. Some plants grow without roots, these are called *air plants*. One of this kind, suspended from the ceiling of a room, will grow and blossom for years.

## CHAPTER VII.

### *Different kinds of Stems.*

144. THE stem is the body of the plant. This is hard and woody in some plants, and soft and watery in others. The oak

141. What are bulbous roots, and why are they most common in cold countries?

142. What is farther remarked of bulbous roots?

143. Are there any plants without roots?

144. What is the stem?



and rose are *woody* plants, the lily and pink are *herbaceous*. Woody plants are divided into *trees* which have large stems called trunks and grow to a great height, and *shrubs* whose stems are smaller and which never grow very high.

145. The use of the *stem* is to support the branches, leaves, and flowers, and to convey to them, by means of certain tubes, such substances as the root absorbs from the earth. The stem also conveys back to the root, by means of another set of tubes, certain juices which have passed through changes in the leaves. If you water a plant with coloured liquid, the stem will in time show that it has ascended into it.

Fig. 19.



146. The *caulis*,\* or proper stem, is seen in forest trees, in shrubs, and in most annual plants. The caulis is either simple, as in the white lily; or branching, as in the geranium; the branching, is the more common form. You have here, Fig. 19, the representation of a *caulis*, or proper stem, (a), a *peduncle*, or flower stalk, (b); and a *petiole*, or leaf stalk, (c). Plants with the real stem, or caulis, are called *cauline* plants.

147. Geologists, by examining rocks, and the petrifications they contain, have found that cauline plants were not created until after such as *herbaceous culms* or *stipes*.

\* From the Greek *kaulos*, a stem.

145. What is the use of the stem?  
 146. Describe the caulis or proper stem.  
 147. What have geologists discovered with respect to the order of creation of plants?

Fig. 20.



148. *Culm*, or straw, (Fig. 20,) is the kind of stem which you see in grasses and rushes. The bamboo, sugar cane, and various species of reeds, have stems of the culm kind; some of them, particularly the bamboo, are known to attain to the height of forty feet. We can imagine something of the appearance which extensive plains of these lofty tropical reeds must present, gracefully bending to the slightest breeze, like our meadow grasses.

Fig. 21.



149. *Scape*. This is a stalk springing from the root, which bears the flower and fruit, but not the leaves; as the Dandelion, the Cowslip, and the Lily of the Valley, (a a Fig. 21). Plants with scapes are sometimes called *stemless* plants.

150. *Peduncle*, or flower stalk. This is a subdivision of the principal stem; it bears the flower and fruit, but not the leaves. When the peduncle is divided, each sub-division is called a *pedicel*.

151. When there is no peduncle or flower stalk, the flowers are said to be *sessile*, which means *sitting down* upon the main stem.

152. *Petiole*. The petiole or leaf-stalk, is a kind of *stalk*, or *ulcrum*, supporting the leaf; it is usually green, and appears to be a part of the leaf itself. In most cases, the leaves and flowers are supported by distinct foot stalks, but sometimes one foot-stalk supports both the leaf and flower.

148. Describe the culm.  
 149. What is a scape?  
 150. What is a peduncle, and what is a pedicel?  
 151. When are flowers said to be sessile?  
 152. What is the petiole?



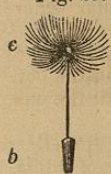
Fig. 22.



153. *Fron*d. Fig. 22. This is where the leaf appears to be a part of the stem, as in the common fern, which bears its flowers and fruit upon the back and edges of the leaf. The palm leaves are called fronds. Plants with fronds and stipes are sometimes called by the general name of *stiped*-plants.

154. By observations of geologists, it is ascertained that *stiped* plants were created before *cauline* ones; since petrifications of the former are found in the lower formations of the earth, while no remains of *cauline* plants are ever found in them. In this sketch of the fern, *a* represents the lower part of the frond, sometimes also called the *stipe*.

Fig. 23.



155. *Stipe*, is the stem or leafless part of a frond, or the stalk of a fungus or mushroom. The term is also applied to the slender thread, which in many of the compound flowers, elevates the hairy crown, with which the seeds are furnished, and connects it with the seed. Thus, in the seed of the Dandelion, which is here represented, the column (Fig. 23, *a*) standing on the seed (*b*) and elevating the down (*c*) is the *stipe*.

153. Describe the frond.

154. What plants, according to the observations of geologists, were first created?

155. What is a *stipe*?

Fig. 24.



156. Here is a mushroom, or Toadstool, with the cap, (Fig. 24, *d*) elevated by its stem or *stipe* (*e*).

157. *Herbaceous* stems usually die every year; in some cases, when the root lives more than one year, the stem is annual, as in the Tulip.

158. *Woody* stems are composed of tough fibres, as the oak, currant-bush, &c. Plants with woody stems are generally much longer lived than herbaceous plants.

159. *Pithy* stems, like the elder, are in their centre composed of a soft substance, called *medulla*, or marrow. Some stems are *solid*, as the Box; *hollow*, as the Onion; and *corky*, as the Cork tree.

160. The stem is either *simple*, or *divided* into branches. The divisions of the main stem are called *branches*; the divisions of the branches are called *branchlets*, or *boughs*.

161. Branches sometimes grow without any regular order; sometimes they are *opposite*; sometimes *alternate*; and sometimes, as in certain species of the pine, they form a series of rings around the trunk. Some branches are erect, as in the poplar; others are pendant, as in the willow; some, as in the oak, form nearly a right angle with the trunk.

162. A remarkable phenomenon is described by travellers as being exhibited by the stems of the Banyan tree of India, called the *Ficus Indicus*; these stems throw out fibres, which descend and take root in the earth. In process of time, the stems become large trees; and thus from one primitive root, is formed a little forest. The tree is called by various names; as the Indian-God-tree, the arched-Fig-tree, &c. The Hindoos plant it near their temples, and in many cases the tree itself serves them for a temple. Milton speaks of this tree as the one from which Adam and Eve obtained leaves to form themselves garments; he says:

156. What is the stem of the mushroom called?

157. What are herbaceous stems composed of?

158. What are woody stems?

159. What other kinds of stems are there?

160. What are branches and boughs?

161. What are the different appearances presented by branches? What is said of the Banyan tree?



"It was not the fig-tree renowned for fruit."

"Such as at this day to Indians known  
In Malabar or Decan, spreads her arms,  
Branching so broad and long, that in the ground  
The bended twigs take root, and daughters grow  
About the mother tree, a pillar'd shade  
High over-arched, and echoing walks between."

You have here a picture of this wonderful tree, which is said to have given shelter to an army of several thousand men

Fig 25.



*Ficus Indicus, or Banyan tree.*

## CHAPTER. VIII.

### *Buds.*

163. Most leaves and flowers proceed from scaly coverings called buds. The scales cover each other closely; the outer ones being dry and hard, the inner moist and covered with down: they are also furnished with a kind of resin, which prevents the embryo or future plant from being injured by too much moisture. Buds have been known to lie for years in water without injury to the infant plant, or branch, within.

164. The sap is the great fountain of vegetable life; by its agency, new buds are yearly formed to replace the leaves and flowers destroyed by the severity of winter.

165. The bud is usually a cone-like protuberance formed by

163. What do most leaves and flowers proceed from?

164. By what agency are new buds formed?

the bud usually make its appearance?

the swelling of the germ: and as for this purpose the agency of an additional quantity of sap is needed, we see the bud appearing at the axils of leaves, or the extremities of branches and stems, where there is an accumulation of this fluid. If you plant a slip of Geranium, you will observe that it either sprouts from the axil of a leaf, or from knots in the stem which answer the same purpose as the leaf, by slightly interrupting the circulation of juices, and thus affording an accumulation of sap necessary for the production of a new shoot.

166. Herbs and shrubs have buds, which usually grow and unfold themselves in the same season, and are destitute of scales; while the buds of trees are not perfected in less than two seasons, and in some cases they require years for their full development.

167. You have, no doubt, observed in the spring, the rapid growth of the leaves and branches of trees; and perhaps, have also noticed, that as summer advances, the progress of vegetation seems almost to cease, and that new leaves and branches do not come forth as before; but you may not have known, that instead of resting in her operations, nature is now busy in providing for the next year; that she is turning the vital energies of the plants to the formation of buds. Those little embryo plants, so nicely wrapped up in downy scales as to be able to bear the coldness of the winter, in the ensuing spring will come forth from their snug retreats, and taking the places of the leaves which had withered in autumn, will delight us with new verdure and beauty.

168. You may here see a representation of two scaly buds; one of which appears as if cut vertically, in order to show the germ or embryo, which is enclosed by the scales.



169. The term bud, in common language, extends to the rudiments of all plants, whether with scales or without, which originate upon other living plants. Buds with scaly coverings are chiefly confined to the trees of cold countries. In the northern part of the United States, there are few trees which can endure the cold weather, without this security. In Sweden, it is said there is but one shrub\* destitute of scaly buds

\* A species of *Rhamnus*, which grows under trees in marshy forests.

166. Do herbs and shrubs have buds?

167. At what period of the year are buds formed?

168. What does Fig. 26 represent?

169. In what countries are the trees mostly furnished with scaly buds?



and this from the peculiarity of its situation, is always protected from the inclemencies of the weather.

170. That there is, in reality, a difference in the nature of vegetables as well as of animals, is very apparent; an orange tree will not form scales to protect its buds from cold; neither can the most delicate tropical animal resist the rigours of a polar climate.

171. There are cases, however, in which plants, as well as animals change their habits. The horse-chestnut, in India, its native climate, unfolds its leaves to the atmosphere, without receiving any check in their development; in a colder climate, the leaves, in attempting to unfold, are checked in their progress, degenerate into scales, and form buds.

172. Of the *bud*, there are three sorts; the *flower-bud*, *leaf-bud*, and *mixed-bud*.

173. 1st. *The flower-bud*, is of a short round form, and contains the rudiments of one or several flowers folded over each other, and surrounded with scales. It is often found at the extremities of small short branches; this is the kind of bud which is employed in grafting or inoculating. This operation is performed by cutting into the bark of another tree, and placing a bud in the aperture; the sap of the tree flows to it, and forms around it a substance which connects the bud to itself; in this situation it shoots forth, and becomes a fruit-bearing branch.

174. 2d. *The leaf-bud* contains the rudiments of several leaves without flowers; it is usually longer and more pointed than the flower-bud.

175. 3d. *The mixed-bud* contains both leaves and flowers. In the peach we have examples of the first two divisions, the leaf and flower-bud being distinct; in the lilac they are enclosed together in the same bud.

176. You have now seen the manner in which buds commence their existence; and how they gradually unfold themselves until they become, in their turn, branches covered with leaves and flowers. In considering this subject, you cannot but have been impressed with a sense of the goodness of that

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170. Does there appear to be any difference in the nature of vegetables?

171. Do plants ever change their habits?

172. How many kinds of buds are there?

173. Describe the flower-bud.

174. Describe the leaf-bud.

175. Describe the mixed-bud.

176. What reflections arise when considering the progress of vegetable life?

great Being, who watches with unceasing care over his vast creation. To observe the progress of life, whether in the vegetable or animal kingdom, is highly interesting to an investigating mind;—but here the power of man can achieve nothing; he may plant and water, but God alone giveth the increase.

177. A bud lives; an infant lives; both are destined to grow and to pass through physical changes; but the bud, although active with a principle of life, knows not its own existence: while the infant becomes conscious of its own powers and faculties, capable of loving those who have contributed to its well-being, and of adoring the great Author of its existence.

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## CHAPTER IX.

### *Of Leaves.*

78. The leaf is generally a thin, flat organ, consisting of an expansion of the fibres of the bark, connected by a substance which is called the *cellular tissue*; the whole is covered with a green coat or skin called the *cuticle*.

179. Leaves are furnished with pores for exhaling and inhaling gases; and as they present to the air a more extended surface than all other parts of the plant, they are of great utility to the vegetable, by imbibing suitable nourishment, and throwing off such gases as would be useless or injurious.

180. We have seen how the bud is formed, and by what curious means the principle of vegetable life which it contains is preserved and protected through the cold and dampness of winter. In the spring, when the sun has turned his course towards the north, re-crossed the equator, and is advancing towards the tropic of Cancer,\* the vegetable world in our region quickened by its stimulating warmth, begins to awaken from its dormant state; the leaf-buds expand, and soon bursting their envelopes, the green leaves come forth.

\* It is here presumed that the pupil has been instructed in the apparent course of the sun, as explained in the common school geographies.

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177. What comparison may be made between a bud and an infant?

178. What is the leaf?

179. How do leaves inhale and exhale gases?

180. When do the leaves usually appear?