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THE OTTAWA NATURALIST

VOL. XXVI. MARCH, 1913 No. 12

SOME CONDITIONS OF PROGRESS IN THE PLANT WORLD.*

By W. T. MACCLEMENT, D.Sc., Professor of Botany, Queen's University.

There is no unanimity as to the meaning of the term *progress*, but I shall use it in the ordinary sense of change, from simplicity of structure to complexity, that is from uniformity of parts to specialization of parts, from every part doing all kinds of work to complete division of labor.

I shall ask you to imagine first a lifeless world in which the only changes were physical and chemical. Condensation, solution, diffusion, combinations, and decompositions all went on vigorously in warm moist surroundings. This may have gone on for ages, but finally, in all probability, as the climax of a long series of combinations and rearrangements, some of these chemical changes resulted in the formation of an unstable, gelatinous substance which we call *Protoplasm*. In spite of much serious study and long continued experimentation man has not yet quite mastered the chemical processes involved in the building up of protoplasm. We know that it is made of carbon, hydrogen, oxygen, nitrogen, phosphorus and sulphur—"the dust of the earth"—and that it is probably a water solution of proteids. Well, this translucent semifluid substance protoplasm was siezed upon by a new force which gave the protoplasm qualities in which it differed in a marked way from any other chemical compound. One of these qualities is the ability of protoplasm to change many other substances into its own substance, thus increasing the quantity of protoplasm. This ability is not possessed by any other kind of matter known to man. We call this new force *Life*, and one of the notable powers of Life is this,—of giving to protoplasm the power to assimilate food, to grow thereby and also to divide itself into two or even many parts, each of which retains all the distinguishing qualities of the parent mass.

*Lecture given before the Ottawa Field-Naturalists' Club, Feb. 25th, 1913.

Unless we are advanced students of psychical research we will agree that the force called life manifests itself *only* through the medium of *matter*. Protoplasm has the distinction of being the *only kind of matter*, in which *life makes itself evident*. We cannot avoid desiring to know what is the real nature of this vital force, and what is its origin. These questions are yet to be answered to the satisfaction of all. Those who desire to reduce all phenomena to known chemical and physical changes, reason as follows:—Life is made evident by the production of energy. Energy is obtained from matter by chemical changes in the matter—for example, we thus get heat, electricity, explosions, etc. The greatest and most continuous manifestations of energy come from the substances which are the least stable. Such substances as protoplasm are notably unstable, and chemical changes accompanied by energy changes are constantly going on in protoplasm. *Life is the summation or resultant of all these changes.* But can this be true? We may easily so act upon protoplasm that the life in it is destroyed, and yet it is protoplasm, and chemical changes go on rapidly in it. But these changes do not constitute life. They soon result in the destruction of the protoplasm. It therefore seems that the relation of life to chemical changes in protoplasm is rather a directive one—life being a power capable of controlling and deciding the kinds of chemical change which may occur in protoplasm. Huxley clearly set forth the difference between living and non-living matter in his famous definition—"Living matter is distinguished by its continual disintegration by oxidation, and its concomitant reintegration by the intussusception of new matter." Just so! Non-living protoplasm is also continually "disintegrated by oxidation," but there is no "concomitant intussusception of new matter." And so the dead protoplasm is gradually consumed. An alternative explanation of the origin of life is that it was "breathed into" protoplasm from some Source of Life outside the protoplasm. This statement, although apparently not scientific, has the advantage of being more difficult to disprove chemically, than any of the chemical explanations at present offered.

Whatever may have been the origin of protoplasm or of the life force within it giving it sensation, mobility, power of growth and of reproduction,—there can be no doubt of the present existence of minute masses of protoplasm having these properties. The conditions in which this first protoplasm lived were probably warmth, moisture and possibly light. Only in the presence of some moisture, and a moderate temperature will life continue active in protoplasm. The source of heat in the primitive world was probably the cooling crust of the earth, but eventually light penetrated the atmosphere and reached the living protoplasm. The simplest masses of protoplasm we are able to study are minute spherical or elongated structures, with a firm boundary or wall, or with a gelatinous envelope. These have two methods of reproducing themselves, the simplest of which is by each merely splitting into two—fission. The other method consists in the material which forms one mass breaking into many small parts within the wall. These parts escape through a rupturing of the wall of the parent cell. Each of these new individuals seems to be exactly like all the others, and is independent of all the others, doing for itself whatever is necessary for its life.

In examining the various one celled plants we are struck by the fact that one great group of them has kept the habit of living each by itself, a distinct individual life, while those of the other group adhere to each other in irregular masses, or even form carefully arranged colonies. We note that most of those that retain their independence live in dark, moist, warm situations, often within larger living creatures, and they accentuate their individual liberty by moving from place to place, through short distances. We call them Bacteria. They never reach any considerable size nor permanence of structure, but being bathed constantly in liquids which yield them nourishment, they increase rapidly in numbers by the process of cleavage, each splitting into two, and these again in a very short time. By this geometric progression they multiply at a prodigious rate, and we are aware that their activity or the poisonous substances they excrete are a menace to the lives of many of the higher creatures which they inhabit. Fortunately for us they have not learned how to protect themselves against light, which when intense exerts a destructive influence on colorless protoplasm. Another weakness of bacteria, and the same is true of nearly all other kinds of fungi, is that each individual is literally "a chip of the old block." The parent really becomes rejuvenated in the form of two offspring made from its material. Let me ask you to note that this is a form of immortality. Here there is no such thing as maturity, old age, and death. Each bacterium literally "renews its youth" by making of itself two new bacteria. Each of these must therefore retain unchanged the qualities of the only parent it has. There is little chance of its receiving any influence which will cause variation, and each is exactly of the character of the line of parents preceding it. Its qualities are rigidly fixed in the type of its ancestors. In this fixity of type and lack of adaptability of the race of fungi we have an important character which aids us when we desire to prevent their growth. If we can modify in any marked degree the conditions surrounding them, we render their existence difficult, if not impossible. An illustration of this is the fact that of all the edible, fleshy fungi known and desired by man, we have learned the conditions of growth of only one, the common Meadow Mushroom, and in spite of many long continued efforts at cultivation by botanists and epicures, not another kind has as yet been tamed.

The fungi "seek darkness rather than light" and usually the only parts which come into the light are those reproductive structures which quickly break down into minute fragments to be scattered by the wind and water. These colorless plants are able to live only by absorbing other protoplasmic substances, either dead or alive. They are therefore not honest in getting their livelihood, but take it from others, although it is true that in some instances they give valuable service in exchange.

Note that in the forms of life thus far mentioned there is no such phenomenon as sex. But when we turn to those which have learned to tolerate light and protect themselves from its harmful power, we at once come into contact with another method of reproduction, and this method has proved so advantageous that all but the lowliest forms of life have adopted it. Sexual reproduction differs from that described as belonging to most fungi, in that each offspring has two parents instead of one. In place of fragments—(spores) falling from one individual, and each spore growing into an individual like the parent—two fragments are necessary, usually one from each of two different individuals, these spores fuse together into one, and this resulting egg has the power of growing into an individual like the parents.

Such an arrangement is evidently much less simple than the other, the sexual way, but, as said before, it has become the method among all higher organisms. There must be very important advantages connected with it. We are not able to give clear and complete reasons for the general adoption of the sexual method, but one advantage has been indicated by contrast. In sexual reproduction—say in *Spirogyra*, one of these simple plants—fragments of two individuals take part in the formation of each new *Spirogyra* individual. The parent filaments of *Spirogyra* being free floating plants, did not grow under exactly similar conditions and are not likely to be offspring of the same two parents. Hence they will have qualities which are somewhat unlike. This variety of qualities will be inherited by their offspring, and the offspring will thereby have more power of adapting itself than though derived from a single parent having but one set of qualities. As the young Spirogyras float about they will certainly have a better power of adapting themselves to the variety of conditions they will meet, than has the young fungus, which has no varied assortment of qualities, derived from a varied assortment of ancestors. It is certain this is an important advantage, but probably there are many others yet to be learned. But mark, that by acquiring adaptability, Protoplasm has secured the power to live under all sorts of conditions, and this is no small advantage.

Let us now turn to the ability of many plants to live in the light. They must in some way prevent the actinic rays from penetrating them through and through. We find that protoplasm has responded to the danger of destruction by light, by the extremely wise method of changing a deadly enemy into a friend and even into a valuable servant. The change, however, is not in the light, but in the protoplasm. In a part of its own substance it develops a green coloring matter—chlorophyll—which it places near the surface, and this absorbs the energy of the light, preventing its destroying the inner protoplasm, and also enabling it, through the energy thus captured, to accomplish some most astounding chemical changes. There are certain substances so stable that when man in his chemical operations forms these substances, he lets them go as waste products. Among these are prominently carbon dioxide and water. The energy required to decompose these substances is so great that under no ordinary conditions of manufacture can we undertake it. But protoplasm, with the energy absorbed from sunlight, quietly takes apart these refractory materials, and builds up their separated elements into such complex substances as starch, fats, and proteids, and as if in derision of man's efforts, gives these to man to be his foods. Man, if properly informed, reverently accepts them, confessing his ignorance and inability to make them for himself. It is suggested—in view of this power of green protoplasm, that greenness is an important stage or condition of progress. Plants lacking greenness have to live as man and the other animals do, on the products of the energy and ability of the green plants. It is because of this power of green plants to manufacture an abundance of food for themselves that large and enduring plant structures and all kinds of animal life become possible. The protoplasm of which we are made, develops in our surface layers when exposed to light, a protective pigment, usually not green, but brown or black. The presence of this permits of human life in intensely lighted regions. Those who do not develop it readily, retreat from the tropics or die.

Having marked the victory of protoplasm over one enemy we may proceed to see how it meets another. We have seen that the presence of warmth and moisture are the prime conditions essential to the life of protoplasm. It should now be noted that these are incompatible conditions, inasmuch as warmth implies the evaporation of moisture, and on the other hand the high specific heat of water keeps at a comparatively low temperature any large body of water. In other words, much heat drives away water, and much water prevents warmth. To have plenty of moisture a plant must be surrounded by water. To have plenty of light and heat it must be out of water. How can these contradictory needs be properly met?

Simple green plants of only one or a few cells might float on the surface of a body of water, enjoying plenty of light and water, but the temperature would be lower than that which is most stimulating to their life-processes. If they drift ashore the heat of the sun will soon remove the water necessary to their life, in spite of the wall of cellulose they construct about themselves. Some new arrangement is necessary. Protoplasm responds to this challenge by keeping the offspring close together, until a mass is formed. The inner ones are kept from the drying air by the outer ones, which are soon destroyed, becoming empty cells, but forming a more or less waterproof and non-conducting coating. This method is another permanent victory over threatening conditions because we find that every kind of creature living in air has adopted this plan of an *epidermis*.

But in this mass of cells, each one demands an equality in exposure to light, warmth and moisture if all have the same work to do, so we find that they have gradually adopted some definite arrangement, regular and symmetrical. It is quite evident that if every cell is to be independent of every other cell, it must be equally exposed to beneficial conditions. This perfect socialistic condition is consummated in Volox—a symmetrical sphere which rotates slowly in the water. It is evident that a small sphere is the climax in this direction, as in a larger one the inner cells would be beyond the reach of light, and possibly of moisture, and even such a sphere must remain in water in order to rotate.

There seems no further progress possible in the face of these opposing conditions. How can anything better be produced? Here Protoplasm had to strike out a new line of progress. We describe it briefly as Division of Labor. The first evidence we have of this is in such small plants as *Riccia*, floating on still water or living on damp soil. Their mass of cells may be compared to the spherical Volvox, but instead of rotating and exposing every surface to light, one side of *Riccia* is permanently set aside to absorb light and air, while the other is devoted to the absorption of water. This division of labor may seem a small advance, but it contains a prophecy of everything we find in the structure of the tallest tree.

The dorsiventral arrangement proved itself a success, and larger land plants of similar arrangement and structure were produced, with an elaborate epidermis and ventilating system.

These were merely flat masses of cells, spread on moist soil. Now came another ministry of progress. Neighboring plants occupying the surrounding territory grow over a flat mass and cut off its supply of light. Protoplasm responds to this danger by breaking the flat expanse into irregular parts attached to a central axis, and this axis soon rises slightly from the soil. This is the condition we find in the mosses. But another danger is at once encountered. Such elevated parts are removed from the necessary water supply, although favorably placed for light and air.

So if elevation of parts is necessary there must be devised a conducting system, and a strengthening system also, to enable the erect plant to resist wind currents. Protoplasm recognizes and meets this difficulty. Among the mosses we find a suggestion of a stem—the green surface is divided into somewhat regular little leaflike parts, and these are placed radially on a short, central axis, which is strong enough to hold them erect a fraction of an inch. But no true conducting structures are met in plants lower than the ferns. There we find that ordinary short roundish cells become immensely elongated, and their side walls strengthened. The presence of these tubes, which permit a ready passage of liquid from the soil to the uppermost parts, makes possible what we have in our most complex groups of plants—roots for absorption deep in the soil, stems and leaves reaching many yards above the soil. These tubes must be held erect against gravity and the destructive rush of the wind. So wood is developed—a mass of cells part of which are modified into tubes and another part into fibres—slender, strong and elastic.

Let us now glance back for a moment and notice that somewhere in the advance from simplicity, there enters the phenome non of Death, as we think of it. We saw that the simplest organisms cannot be said to die, inasmuch as the living parent is merged in the offspring of which it forms so considerable a part.

But apparently as an associated condition with the evolution of sex came the need of a certain maturity of parent, and the germ cells became at length not the whole of the parent but only a small proportion of its mass. Then we find that the mature plant produces germ cells only once, or a limited number of times, and after such definite effort at reproduction, the parent dies, except as represented by its offspring, to which it has contributed a minute portion. This small contribution from the parent carries with it a wonderful power of heredity, but not sufficient to prevent variation, or to enable us to say that the individuality of the offspring is lost.

The fact of variation is undeniable, we may find examples in every family, and in the leaves of every tree. The possibility of variation must be acknowledged. But notice that an outside force such as heat or light can do no more than act as a stimulus. The Protoplasm, so far as we can see, might have lived along the line of least resistance, flourished where conditions were entirely favorable, and died out wherever light, heat, etc., became too great. But life has spread from quiet waters to cover the face of the earth, adapting itself by increasing complexity to every variety of condition found on a globe which is far from monotonous in surface. I believe that it does so because Progress is a law of Life. By that I mean that the Creator of Life has stamped His design on living matter, so that it does not yield to difficulties, but matches itself against threatening conditions and makes them servants—steppingstones. This belief makes a chemical origin of life unthinkable, as no known series of chemical changes holds within it the necessity of progress. We recognize that in mental and moral life we cannot stand still, we either advance or retrograde. But just so surely as progress is an inseparable condition to success in living, so a perpetual struggle with the environment of life seems an inseparable condition for progress. This in the world of matter is doubtless what the poet implies as ruling in the world of spirit—"Wher'ere the prizes go, grant me the struggle that my soul may grow."

ADDITIONS TO THE FLORA OF VANCOUVER ISLAND.

By J. M. MACOUN, Assistant Naturalist,
Geological Survey of Canada.

(Continued from page 149).

99. Claytonia Chamissoi, Ledeb.
    Comox.
100. Portulaca oleracea, L.
    Cowichan Station.
101. Dianthus Armeria, L.
    Vicinity of Victoria.
102. Silene Armeria, L.
    Raymond's Crossing.
103. Lychnis coronaria, (L.) Desv.
    Nanaimo.
104. Agrostemma Githago, L.
    Cowichan River (Clendenning); Victoria.
105. Cerastium campestre, Greene.
    Most of the references to *C. arvense* in previous publications are this species.

106. Cerastium graminifolium, Rydb.
Cadboro Bay and Xmas Hill, Victoria; Cowichan Lake.
107. Stellaria longifolia, Muhl.
Newcastle Island, Departure Bay.
108. Stellaria humifusa, Rottb.
Newcastle Island; Ucluelet.
109. Stellaria strictiflora, (Rydb.)
Beaver Lake.
110. Sagina stricta var. maritima, Fries.
Langford Lake.
111. Spergula sativa, Boenn.
Common. Listed as *S. arvensis*.
112. Spergularia salina var. leiosperma, Kindb.
Sidney.
113. Clematis ligusticifolia, Nutt.
Running wild at Departure Bay.
114. Anemone Hudsoniana, (DC.) Richard.
Koksilah. First collected there by Mr. J. R. Anderson.
115. Thalictrum occidentale, Gray.
Cowichan Lake. (Glendenning; Anderson; Macoun) Koksilah River.
116. Batrachium Lobbii, A. Gray.
Lost Lake.
117. Ranunculus flammula var. reptans (L.) Schlecht.
Nanaimo. (Fletcher and Anderson) Shawnigan Lake; Cowichan River; Ucluelet; Strathcona Park.
118. Ranunculus Eschscholtzii, Schlecht.
Mount Arrowsmith. (J. R. Anderson). North of Cowichan Lake; Strathcona Park.
119. Ranunculus pennsylvanicus, L.
Ucluelet.
120. Ranunculus acris, L.
Sparingly naturalized.
121. Ranunculus platyphyllus, (Gray) Piper.
Comox; Cadboro Bay; Cowichan Lake.
122. Caltha asarifolia, DC.
Comox.
123. Trollius laxus, Salisb.
North of Cowichan Lake; Strathcona Park.
124. Coptis asplenifolia, Salisb.
Renfrew district. (Rosendahl). Cumberland (W. B. Anderson); Comox; Ucluelet.
125. Eschscholtzia californica, Greene.
Beacon Hill.

126. Eschscholtzia recta, Greene.
Cameron Lake.
127. Draba verna, L.
Cadboro Bay.
128. Lobularia maritima, Desv.
Victoria.
129. Dentaria geminata, Wats.
Koksilah River. (R. H. Jameson).
130. Dentaria macrocarpa, Nutt.
Burnside Road near Victoria.
131. Cardamine occidentalis, S. Wats.
Kennedy Lake near Ucluelet.
132. Cardamine intermedia, Holm.
Victoria; Wellington; Nanaimo; Ucluelet.
133. Cardamine kamschatika, (Regel) Schultz.
Victoria.
134. Arabis glabra (L.) Benth.
Cowichan River (Glendenning); Esquimault; Nanaimo; Ucluelet; Strathcona Park.
135. Arabis lyrata var. occidentalis, S. Wats.
Cowichan Lake.
136. Arabis Drummondii, Hook.
North of Cowichan Lake, alt. 4,000 ft.
137. Arabis Hookeri, Lange.
Cowichan Lake.
138. Radicula indica (L.)
Nanaimo.
139. Radicula Nuttallii, Rydb.
Beaver Lake; Lost Lake.
140. Barbarea americana, Rydb.
Cowichan River. Other V. I. specimens are *B. vulgaris*.
141. Erysimum elatum, Nutt.
Mount Arrowsmith; Cameron Lake. (J. R. Anderson). Strathcona Park.
142. Brassica occidentalis, Rydb.
Victoria.
143. Sisymbrium altissimum, L.
Victoria; Nanaimo.
144. Hutchinsia procumbens (L.) DC.
Beacon Hill.
145. Lepidium densiflorum, Schw.
Nanaimo.
146. Lepidium strictum, Ruttan.
Cadboro Bay.

147. Lepidium Draba, L.
Victoria. (J. R. Anderson).

148. Senebiera didyma, Pers.
Victoria; Nanaimo.

149. Cakile edentula, (Bigel.) Hook.
Long Beach above Ucluelet.

150. Sedum divergens, S. Wats.
Mount Benson.

151. Rhodiola alascana, Rose.
Chatla Village, west coast.

152. Boykinia vancouverense, Rydb.
Goldstream; Ucluelet.

153. Boykinia cicinnatum, Rosendahl and Rydb.
Cowichan River. *B. elata* is not rare.

154. Leptarrhena amplexifolia (Stenb.) Ser.
North of Cowichan Lake; Strathcona Park.

155. Saxifraga Tolmiei, T. & G.
Lady Mountain. (J. R. Anderson). Strathcona Park.

156. Saxifraga rufidula, Small.
Type collected on Mount Finlayson. Parson's Mountain; Mount Malahat; Cowichan Lake; Mount Arrowsmith.

157. Saxifraga bidens, Small.
Cowichan Lake. (Glendenning). Type collected, Cedar Hill. Not rare around Victoria.

158. Saxifraga odontophylla, Piper.
Mount Arrowsmith.

159. Tiarella unifoliata, Hook.
Departure Bay; Ucluelet.

160. Mitella Breweri, Wats.
Mts. north of Cowichan Lake.

161. Leptaxis Menziesii (Pursh.) Raf.
Renfrew district (Rosendahl). Common in the Cowichan valley.

162. Ribes laxifolium, Pursh.
Barkley Sound; Ucluelet.

163. Spiræa salicifolia, L.
Ucluelet. Introduced with cranberry plants from the east.

164. Rubus nivalis, Dougl.
Comox. (W. B. Anderson). Beaufort Range. (J. R. Anderson). Strathcona Park.

165. Rosa nutkana var. hispida, Fernald.
Colquitz River.

166. Potentilla monspeliensis, L.
Wellington; Ucluelet.
167. Potentilla gracilis, Dougl.
Not uncommon around Victoria.
168. Potentilla nivea, L.
Mount Arrowsmith. (Anderson and Fletcher).

NOTE.—Many species of *Potentilla* and *Fragaria* have been separated from those recorded in previous lists, too many for citation.

169. Sibbaldia procumbens, L.
Mts. north of Cowichan Lake; Strathcona Park.
170. Geum oregonense, Scheutze.
Not rare; confounded with *G. macrophyllum*.
171-2. Amelanchier florida Lindl. and A. Cusickii are both common. Referred usually to *A. alnifolia*.
173. Pyrus occidentalis, Greene.
Mts. north of Cowichan Lake; Strathcona Park.
174. Pyrus sitchensis, (Rœm.) Piper.
Mount Prevost. (J. R. Anderson). Strathcona Park.
175. Lupinus littoralis, Dougl.
Comox; Nanaimo.

NOTE.—Several species of *Trifolium* have been separated from those recorded.

176. Vicia lathyroides, L.
Langford Plains.
177. Lathyrus littoralis, (Nutt.) Endl.
Ahousett. (J. R. Anderson). Ucluelet.
178. Lathyrus pauciflorus, Fernald.
Esquimault; Sidney; Departure Bay.
179. Geranium Bicknellii, Britton.
Wellington.
180. Callitriche Bolanderi, Hegelm.
Victoria; Elk Lake; Cowichan Lake; Ucluelet.
181. Empetrum nigrum, L.
Mount Whymper; Ucluelet; Strathcona Park.
182. Rhus diversiloba, Torr. & Gr.
Saanich Arm. (J. R. Anderson).
183. Pachystima macrophyllum, Farr.
Apparently the commoner species on Vancouver Island.
184. Malva neglecta, Wallr.
Beacon Hill.
185. Hypericum perforatum, L.
Koksilah.

186. Elodea campanulata, Pursh.
Ucluelet. Introduced from the east with cranberry plants.
187. Viola ophioides, Greene.
Victoria; Shawnigan Lake.
188. Viola fulcrata, Greene.
Cowichan River. (J. R. Anderson).
189. Viola compacta, Greene.
Shawnigan Lake; Brehm Lake. (J. R. Anderson). Several species of violets are yet to be described.
190. Epilobium latifolium, L.
Renfrew district. (Rosendahl).
191. Epilobium adenocaulon var. occidentale, Trelease.
Common.
192. Epilobium alpinum, L.
Mts. north of Cowichan Lake; Strathcona Park.
193. Epilobium luteum, Pursh.
Between Buttle's Lake and Grand Central Lake. (Mr. Wood, M.P.)
194. Circæa pacifica, Aschers & Magnus.
Departure Bay; Cowichan Lake; Strathcona Park.
195. Hippuris montana, Ledeb.
Strathcona Park.
196. Sanicula tripartita, Suksdorf.
Victoria Arm.
197. Caucalis microcarpa, Hook. & Arn.
Departure Bay.
198. Osmorhiza Liebergi, Coult. & Rose.
More common than *O. divaricata*.
199. Pyrola elliptica, Nutt.
Cowichan Lake.
200. Arctostaphylos media, Greene.
Nanaimo River. (J. R. Anderson). A hybrid between *A. tomentosa* and *A. Uva-ursi*.
201. Vaccinium Vitis-Idæa, L.
Ucluelet.
202. Vaccinium ovalifolium x parvifolium.
A hybrid between these species was found in several places in Strathcona Park.
203. Dodecatheon sp.
Two of the species of *Dodecatheon* growing on Vancouver Island are well known, a third found at Nootka and Ucluelet has not yet been described.
204. Lysimachia terrestris (L.) BSP.
Ucluelet. Introduced with cranberry plants from the east.

205. Gentiana Douglasiana, Bong.
Renfrew district. (Rosendahl). Ucluelet.

206. Menyanthes crista-galli, Menzies.
Renfrew district. (Rosendahl).

207. Menyanthes trifoliata, L.
Common.

208. Gilia intertexta, Steud.
Near Victoria.

209. Nemophila parviflora, Dougl.
Near Victoria; Cowichan Lake. Earlier records of *N. parviflora* are *N. pustulata* or *N. sepulata*, both of which are common around Victoria.

210. Phacelia heterophylla, Pursh.
Cottonwood Creek, Cowichan Lake.

211. Romanzoffia unalaschensis, Cham.
Barkley Sound; Ucluelet; Cottonwood Creek, Cowichan Lake. *R. sitchensis* has been collected in several localities.

212. Myosotis laxa, Lehm.
Cowichan valley. (Glendenning). Elk Lake near Victoria; Departure Bay.

213. Allocarya phlebeia, Greene.
Not rare near Victoria.

214. Mentha arvensis (L.) var. lanata, Piper.
Colquitz River; Elk Lake; Wellington.

215. Collinsia tenella, (Pursh.)
Not rare.

216. Chelone nemorosa, Dougl.
Renfrew district. (Rosendahl).

217. Mimulus Langsdorfii var. platyphyllus, Greene.
Nootka; Ucluelet.

218. Mimulus pilosus (Benth.) S. Wats.
Swan Lake.

219. Gratiola virginiana, L.
Near Victoria; Comox.

220. Veronica alpina, L.
Mts. north of Cowichan Lake; Strathcona Park.

221. Castilleja angustifolia, (Nutt.) G. Don.
Cowichan Lake.

222. Castilleja rexifolia, Rydb.
Cottonwood Creek, Cowichan Lake.
C. miniata, *C. levisecta* and *C. angustifolia* var. *Bradburii* are common and at least two other species remain to be described.

223. Orthocarpus sp.
Oak Bay; Fowl Bay; Sidney.

224. Pedicularis sp.
An undescribed species collected in Strathcona Park, 1912.

225. Utricularia occidentalis, A. Gray.
Ucluelet. New to Canada.

226. Utricularia intermedia, Hayne.
Ucluelet.

227. Plantago macrocarpa, Cham. & Schl.
Ucluelet.

228. Galium kamtschaticum var. oreganum, (Britton).
Bear Lake, Cowichan Lake.

229. Galium trifidum var. subbiflorum, Wiegand.
Colquitz; Wellington; Ucluelet.
The var. *pacificum* is not rare.

230. Viburnum pauciflorum, Pylaie.
Comox; Cowichan Lake; Strathcona Park.

231. Echinocystis oregana, Torr. & Gray.
Saanich (J. R .Anderson).

232. Heterocodon rariflorum, Nutt.
Victoria.

233. Solidago canadensis, L.
Chemainus.

234. Solidago lanceolata, L.
Ucluelet. Introduced with cranberry plants from the east.

235. Solidago glutinosa, Nutt.
Mount Benson. (J. R. Anderson; Macoun).

236. Aster occidentalis var. intermedius, Gray.
Elk Lake.

237. Aster Cusickii, Gray.
Victoria.

238. Aster Eatoni (Gray) Howell.
Elk Lake.

239. Aster microlonchus, Greene.
Fowl Bay, Victoria.

240. Aster sp.
An undescribed species collected in Strathcona Park, 1912.

241. Erigeron sp.
An undescribed species collected in Strathcona Park, 1912.

242. Anaphalis margaritacea var. subalpina, Rydb.
Elk Lake.

243. Anaphalis margaritacea var. occidentalis, Greene.
Not rare but not so common as typical *A. margaritacea*.

244. Gnaphalium uliginosum, L.
Elk Lake.
245. Antennaria erigeroides, Greene.
Mount Benson.
246. Antennaria eximia, Greene.
Mount Benson.
247. Antennaria chlorantha, Greene.
Mount Benson; Cowichan Lake; Strathcona Park.
248. Antennaria sp.
An undescribed species collected in Strathcona Park.
249. Franseria cuneifolia, Nutt.
Ucluelet.
250. Madia sativa, Molina.
Victoria.
251. Rudbeckia hirta, L.
Cowichan valley. (Glendenning).
252. Erigeron canadense, L.
Cowichan valley. (Glendenning). Sidney.
253. Achillæa borealis, Bong.
Ucluelet.
254. Tanacetum huronense, Hook.
Renfrew district. (Rosendahl). Clayoquot; Ucluelet.
255. Artemisia gnaphalodes, Nutt.
Departure Bay.
256. Senecio fastigiatus var. Macounii (Greene) Greenman.
Langford Plains; Mount Benson; Wellington.
257. Senecio sp.
An undescribed species collected in Strathcona Park.

As was said in the introductory sentences, the above list of additions to the species recorded from Vancouver Island is by no means complete. Some common species and many introduced species have been omitted for want of space. Neither does the available space permit of the inclusion of synonymy. A few species have been included which were recorded in publications that are not accessible to the average collector. There are in the herbarium of the Geological Survey many sheets of specimens from Vancouver Island which have not yet been determined or of which the determinations are doubtful. These, when correctly named, will, with the introduced plants, add at least a hundred species to the above list.

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