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Errata

Page 73, line 14, for "plant" read "plate."

Page 145, last footnote, for "1904" read "1901."

Page 161, line 4, for "about" read "above."

Page 168, line 24, for *1855* read *1955*.

Page 220, line 38, for "thus" read "this."

Page 387, line 3, for MELICA NITENS read **Melica nitens.**

Page 397, second footnote, for "Annals of Botany, *ined.*" read "Bull. Torrey Club **32** : 515–529."

Page 619, line 37, for *A. spathulatus* read *N. spathulatus.*

The most important error in the *Index to American botanical literature* which has been noted is the following:

Tilton, G. H. Incorrectly spelled **Filton** (page 52). A corrected entry appeared in the December number (page 674).

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CONTENTS

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THE TORREY BOTANICAL CLUB

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, Francis E. Lloyd, Columbia University, New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 2, 3, 5, 13, 20, 21, and 24–31 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Dr. John Hendley Barnhart, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Dr. Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 32 No. 1

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JANUARY, 1905

Chemical stimulation of a green alga*

BURTON EDWARD LIVINGSTON

OUTLINE

INTRODUCTORY

That certain activities of plants, notably that of growth, are accelerated by many mineral poisons when the latter are applied in very great dilution has long been known in a general way. The nature of this toxic stimulation and how it is brought about are, however, as little known as are the vital functions themselves. Indeed, until very recently no quantitative data have been available regarding such responses, either in plants or animals. Thus it appeared worth while to undertake a comparative study of toxic stimulation, using a single form of plant and as large a number of poisons as possible. The present paper embodies the results of

* The principal part of the investigations described in this paper was carried on at the New York Botanical Garden by the aid of a research scholarship from that institution during September to December, 1903.

[The BULLETIN for December (31: i–v, 621–682) was issued 9 Ja 1905.]

the first section of this problem, and deals with the effects of what are termed the positively charged ions from dissociated mineral salts.

In the following pages the term *stimulation* will be used to denote any catalytic effect upon vital activity, brought about by any change of the conditions under which the organism is living. Thus, any substance which, upon entering the protoplasm, causes either an acceleration or a retardation of certain functions, is a stimulating agent. Death itself, when it results from poisons at least, is merely the last of a series of stimulation responses, or, rather, it is the final summation of such responses, and appears as a single one only because we have not yet been able to unravel the vast tangle of activities of which it is the resultant.

Two ends must be held in view in a research of this kind. First, analysis is to be made of the conditions which bring about the response, and determination of their manner of action. Second, knowing in this way something of the sets of conditions which stimulate, it will eventually be possible, it is hoped, to interpret the latter so as to throw light upon the nature of the stimulated processes themselves. It is by this means that we may hope to gain more definite knowledge of the complex system of energy changes which make up vitality. Thus the problem may be approached in somewhat the same manner as that in which the chemist attacks a new organic compound, by studying in a quantitative way the effects of various reagents upon it. In this case of the chemist, the reagents are at least better known than the body to which they are applied, and the same must be true in physiological work. For a study of toxic stimulation, a knowledge of reagents comes, of course, from the realm of physics and chemistry.

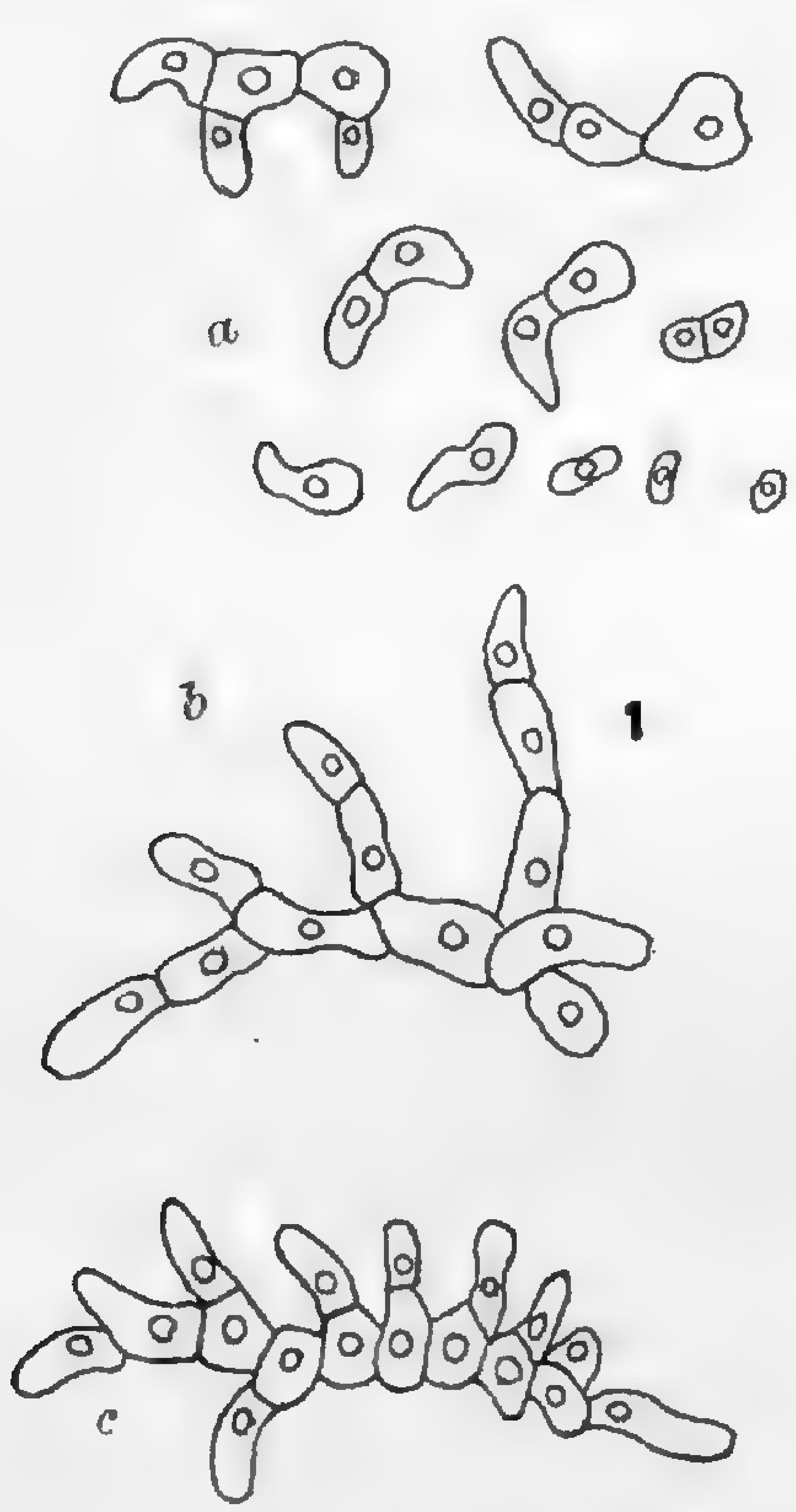
The organism used in the experiments here described is the same form of *Stigeoclonium* whose responses to changes in external osmotic pressure were worked out some time ago.* A brief

* Livingston, B. E. On the nature of the stimulus which causes the change of form in polymorphic green algae. Bot. Gaz. **30**: 289–317. 1900. — Further notes on the physiology of polymorphism in green algae. Bot. Gaz. **32**: 292–302. 1901. — The rôle of diffussion and osmotic pressure in plants 132–137. Chicago. 1903. (These pages are included in the reprint of the last chapter of the volume, entitled, The influence of the osmotic pressure of the surrounding medium upon organisms. Chicago. 1903.) A portion of the résumé here given is taken from the last reference.

résumé of the previous results is here given. In nutrient media whose osmotic pressure is from 323.7 cm. to 647.4 cm. of mercury, the alga appears as groups of spherical cells with thickened and somewhat gelatinous walls. Multiplication takes place rather slowly, cell-division occurring in all directions, and the daughter cells immediately become spherical, so far as this is not prevented by adjacent cells. Often this process of rounding off results in the entire separation of cells, so that a culture of this sort usually exhibits numerous free cells of perfectly spherical form. In weaker solutions, whose pressure is below 161.8 cm. of mercury, the daughter cells elongate into branching filaments composed of cylindrical cells and having the typical appearance of the smaller forms of the genus *Stigeoclonium*. Growth is more rapid here than in the strong solutions. If filaments are transferred to a strong solution their cells round up and often separate, thus producing the other form, and growth continues in the manner first described. In the weak solutions zoöspores are formed in great numbers and germinate to form filaments; in the strong solutions they are not formed at all, and if transferred to such media they fail to germinate, many of them, however, passing by direct enlargement to the conditions of free spherical cells which later behave in accordance with the pressure of the medium, as outlined above. The biciliate zoöspores are produced by simple segmentation of the entire cell-contents, which are freed by a final bursting of the sporangium wall.

A resting zoöspore and several stages in the germination of these bodies are shown at *a*, *fig. 1*; at *b* is shown a more mature filament, as these normally occur floating on the surface of the weak solution; while at *c* is shown a form with more crowded branches, which is usually exhibited on the bottom of the culture dish, where air has not such free access. The spherical form, known usually in such algae as the palmella form, is shown in *fig. 2*. The groups of cells at *a* and *c* have developed from filaments which were transferred from a weak to a strong solution. The filamentous form is still to be seen in both groups, although it has well nigh disappeared in the lower. At *b* are some free cells in process of division which would result in groups of the palmella form.

This investigation was begun and about half finished in the laboratories of the New York Botanical Garden, where it was my good fortune to hold a research scholarship during the autumn of 1903. Through the kindness of the Director in Chief and of the Director of the Laboratories, the facilities for the work were practically unlimited. The experiments were completed at the Hull Botanical Laboratory of the University of Chicago during the winter and spring just passed.



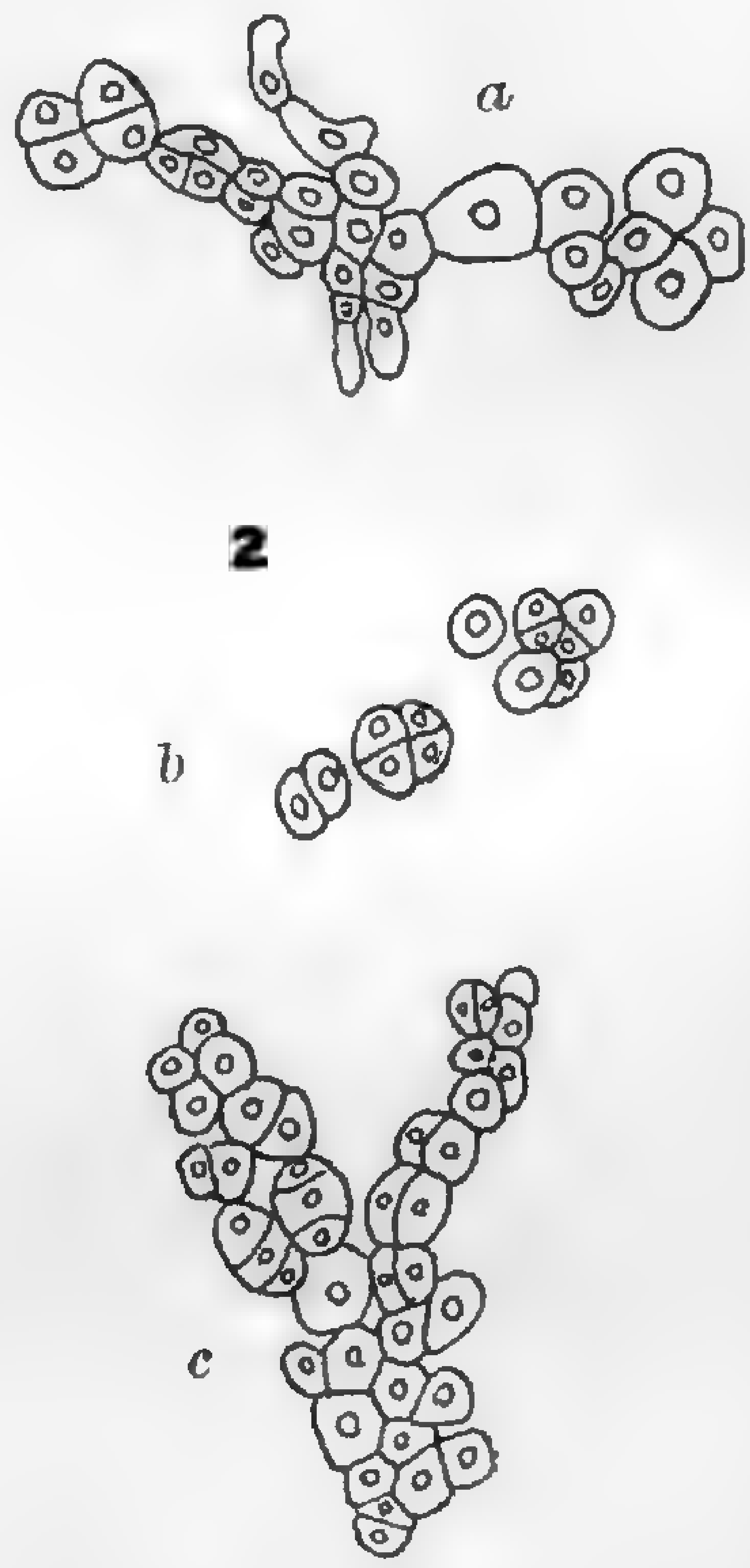


Figure 1. Normal filaments, from weak nutrient solution.
Figure 2. Normal palmella, from strong nutrient solution.

Methods

A modification of the well-known Knop's nutrient solution was used as a basis for the culture media and for the controls. The differences between this and the true Knop's solution are such as to make the former more easy of preparation when the chemistry of the mixture is to be considered. The formula, and certain physical properties of this standard culture medium are shown in the following table. The concentration data for the salts are given in terms of a normal solution, *i. e.*, one gram equivalent per liter of solution.* The osmotic pressure data are computed from Δ_f, the lowering of the freezing point below that of distilled water †, measured in Centigrade degrees.

FORMULA AND OSMOTIC PRESSURE OF NUTRIENT MEDIUM

Salts.	Concentration.	Lowering of freezing pt. (Δ_f)	Osmotic pressure.		
			mm. Hg.	Atmospheres	M.
$Ca(NO_3)_2$	$15n/10,000$				
KNO_3	$4n/10,000$				
$MgSO_4$	$4n/10,000$	0.006°C.	60.09	0.079	0.0035
K_2HPO_4	$4n/10,000$				
$Fe(NO_3)_2$	$n/100,000$				

The above solution was made up from normal solutions of the component salts. Practically no $Ca_3(PO_4)_2$ is precipitated if the K_2HPO_4 is added to the other salts only after the addition of nearly all the required water.

In the control medium just described the alga takes the filamentous form, and zoöspores are plentiful. For the palmella form a solution of one hundred times the strength of this was used. The iron salt, however, was not increased in amount.

On account of the extreme complexity of the general question of toxic stimulation, it seemed expedient to work with but one of the two forms of this alga. By the use of poisons it has been so far impossible to cause a strong solution to produce other than the palmella form, but weak solutions can be made to produce this form at will, as will be shown in this paper. Therefore the filamentous form was chosen as the most responsive and thus the best suited to the work in hand.

On account of the well-known toxicity of certain metals, and

* Throughout this paper the decimal system will be used to denote fractions of normal solutions rather than the cumbrous method of dilutions by one half commonly in use by chemists. One is easily reducible to the other, but it seems that for modern workers the decimal system is by far the better. The form of the common fraction is retained on account of a somewhat greater ease of reading.

† For the method of making this calculation, see Livingston, B. E. The rôle of diffusion and osmotic pressure in plants, 37 (Chicago, 1903), and the references given on that page and at the beginning of the volume. The osmotic pressure, in millimeters of mercury, of a solution at 25° C. (P_{25}) is approximately given by the formula: $P_{25}=10,014.84\ \Delta_f$. This quantity in terms of M (22.3 atmospheres, the calculated pressure of a molecular solution of a non-electrolytic and non-hydrating body) is given by the formula: $P_{25}=0.59\ \Delta_f$.

in order to simplify the otherwise almost hopelessly complicated methods, the problem was further restricted by confining attention to the cations * alone. In order to do this it was necessary to use as stimulating agents salts whose anions were already present in the control solution described above. Soluble nitrates and sulfates were chosen for this purpose. Normal or decinormal solutions of these salts were made up as accurately as possible, and these were diluted to the concentrations needed for the cultures. Since the addition of the poison to the nutrient solution would necessarily dilute both solutions to some degree, the following method of mutual dilution was adopted. The nutrient solution was made up to nine-tenths of its required volume, while the poison solution for each culture was prepared ten times its required concentration, or one tenth of its required volume. Thus, for control culture, 9 c.c. of stock nutrient solution plus 1 c.c. of water was used, and for any concentration of poison (say *kn*, *k* being any fraction of normal), the culture medium was composed of 9 c.c. of nutrient solution plus 1 c.c. of 10 *kn* poison. An example will illustrate this: Suppose that it was desired to test the effect of *n*/10,000 H_2SO_4. 1.5 c.c. of *n*/1 $Ca(NO_3)_2$ was taken, together with 0.4 c.c. each of *n*/1 KNO_3 and *n*/1 $MgSO_4$, and 1.0 c.c. of *n*/100 $Fe(NO_3)_2$. After mixing, these were diluted to a volume of 899.6 c.c. and then there was added 0.4 c.c. of *n*/1 K_2HPO_4. A further addition of 100.0 c.c. of water would have produced the control medium. To 9.0 c.c. of this "9/10 dilution," was added 1.0 c.c. of *n*/1000 H_2SO_4. It is readily seen that through mutual dilution both sets of ions come to be of the desired concentration, the H_2SO_4 being now *n*/10,000. The slight increase in the osmotic pressure of the experiment solution over that of the control, due to the addition of the poison itself, is, in most cases, physically negligible (because of the extreme dilutions used), and is always physiologically so (because of the comparatively high concentration limits for the response of this form, as previously † determined). Poisons of as high concentration as *n*/100 have been used in only a few cases.

The poison salts added to the nutrient solutions were also

*The terminology of the ionic theory is here used, merely because it is most convenient.

†Livingston, B. E. 1900 and 1901, *loc. cit.*

used in such dilution that the slight increase in NO_3 and SO_4 ions caused by the addition could have no effect upon the plant. To test this, variations in the amount of nitrate and sulfate were tried over a greater range than that required for the main series of experiments, but without any response in the plant. This is in agreement with the results published previously (*loc. cit.*, 1900), wherein the effect of a decrease of nine-tenths in the amount of any salt in Knop's solution and an increase in the other three main salts sufficient to keep the pressure constant, was found to be without response in the plant.

Kahlbaum salts were used throughout the work and the utmost pains were taken to have the concentrations correct. All water was distilled in block tin and redistilled in glass.

Pure cultures of the alga were made in the standard nutrient solution and from these the inoculations were make for the experiments. These inoculations were made with wood tooth-picks in place of the usual needle. Sterilization was found not to be necessary, there being no organic bodies in the solutions, and a new tooth-pick was used for each individual culture. Upwards of fifty cultures were usually made at a time, the poison solutions having been prepared in small bottles a day or two before and kept stoppered. The dishes used were the Bausch & Lomb glass culture dishes, about 4.5 cm. in diameter and 2.0 cm. high, with a lid fitting down upon a shoulder after the manner of a pill-box. Ten cubic centimeters of solution were used for each culture. At the New York Botanical Garden the experiments were carried on partly on glass shelves against the pane of an east window, partly in a cool experiment house, and partly on tables directly under a large skylight. At the Hull Laboratory they were placed on glass shelves against a west window. The alga does not require strong light and grows best at a comparatively low temperature. Thus an east or west window of a ordinary laboratory room is well suited for its growth. Cultures came to maturity somewhat earlier in the experiment house than in the laboratory. An experiment ran from twelve to twenty days, being examined *in the dish*, with the low powers of the microscope at critical times, — every day or two for the first few series.

All of the data given are derived from cultures repeated several times. The number of the cultures amount to 1,048 in all.

EXPERIMENTATION

I. PRELIMINARY. — The responses of the filamentous form of this plant to toxic salts are of three somewhat distinct types: (1) death, (2) change in phenomena of growth, and (3) change in phenomena of reproduction. The fatal concentration was determined for most of the salts tested. At a concentration somewhat below the fatal strength, all of the salts cause the filaments to take the palmella form. That is, the presence of the toxic salt causes the plant to behave in this regard as though it had been placed in a solution of relatively high osmotic pressure. The cylindrical cells become spherical and division proceeds in the normal manner as described for the palmella form. But many of the salts also produce, at a certain concentration, another response, namely an acceleration in the production of zoöspores, so that a poisoned culture shows zoöspores sooner and in greater number than does the control without the poison. This often occurs at a concentration where only the palmella form is produced, and here the zoöspores cannot germinate as filaments. They act in this case as though they had been placed in a strong solution. Some of them die and others simply enlarge and become free palmella cells. These points will be discussed more fully farther on.

II. STATEMENT OF RESULTS. — Following is a description of the responses to the different reagents employed. The salts are arranged in alphabetical order according to the English name of the metal. The figures are all camera drawings and the magnification is about 300 diameters.

1. Aluminium nitrate ($Al_2(NO_3)_6$). — Filaments are all killed in *n*/10,000. In 5*n*/100,000 most of the cells die, but what few resist the poison for the first week develop into the palmella form. No zoöspores are produced. (See *fig. 4*, wherein are shown a parenchyma-like mass of cells, three groups of two cells each, and two single cells. Of one of the groups of two, one cell has died after making the palmella form, as is indicated by the granules within. The similar granules lying about the culture are remains of dead cells.) In a concentration of *n*/100,000 the majority of the cells become spherical or nearly so but a number still die. Also, there is here a marked production of zoöspores, which form spherical cells immediately after germination, usually by the time they have reached the two-celled stage. (See *fig. 5*. Here the dead filament-cells are denoted by dotted contents, the same methods will be used in the following figures. A number of empty sporangia are shown at *a*, together with zoöspores in var-

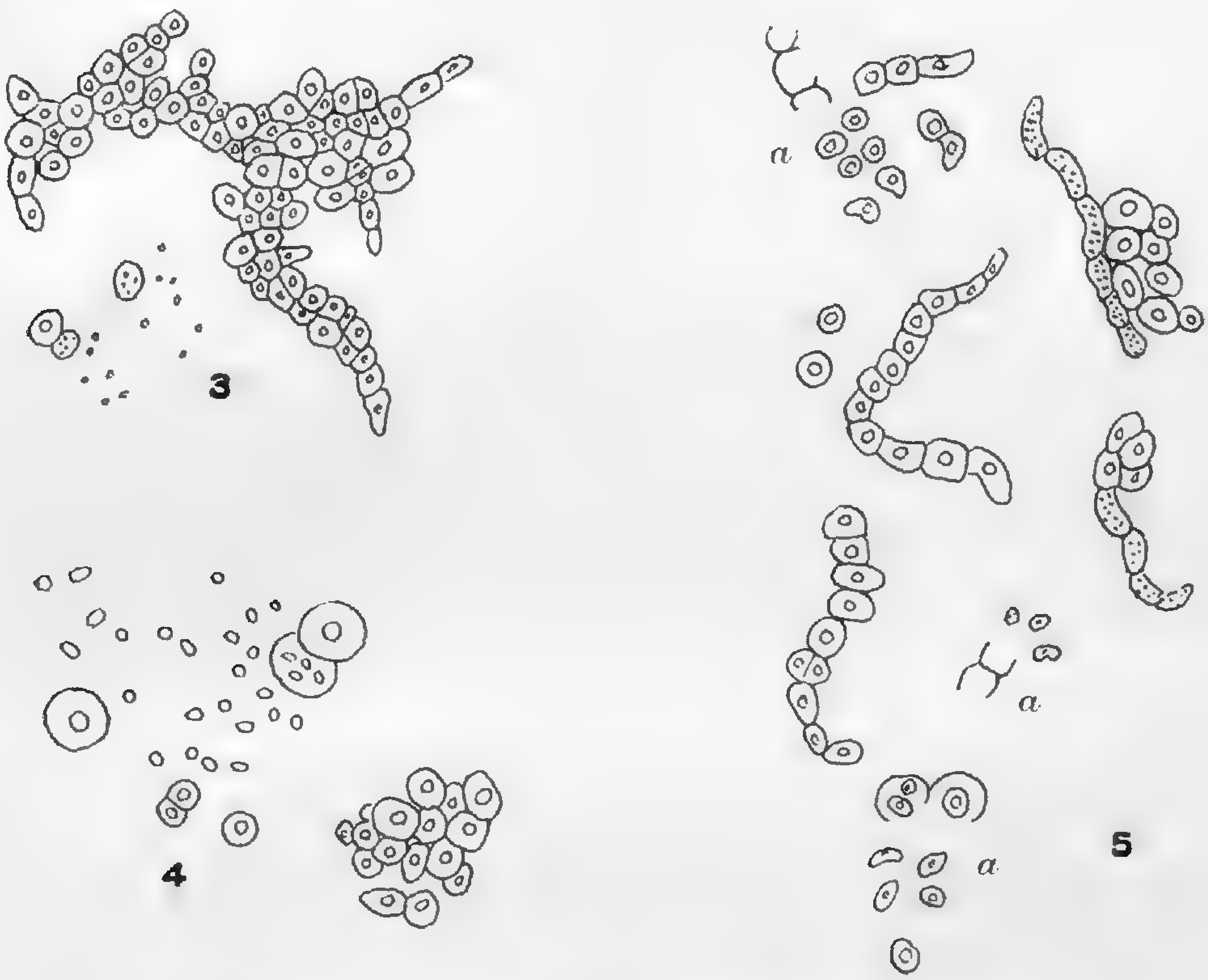


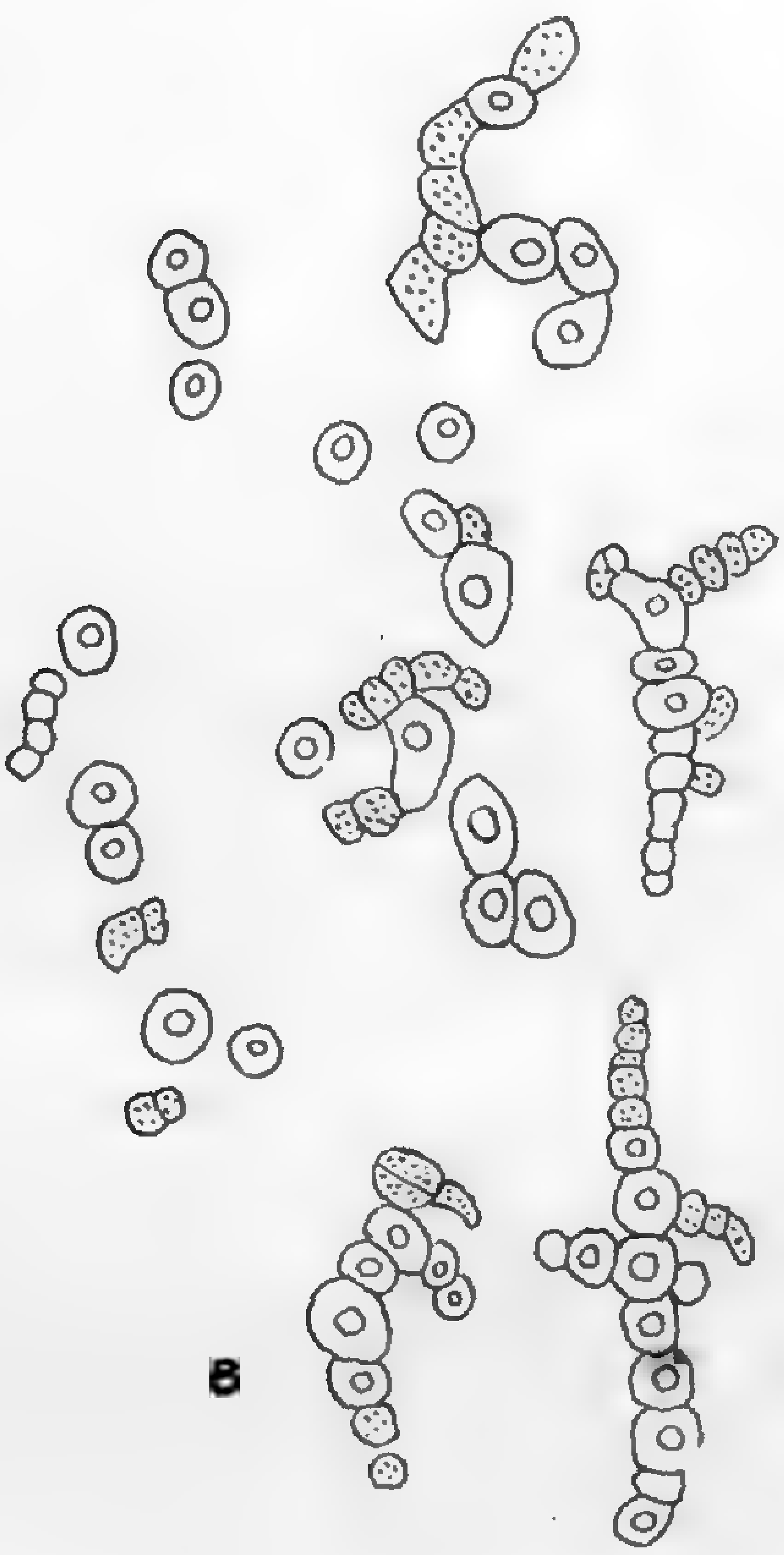
FIGURE 3. Palmella and dead cells from $5n/100,000$ $Al_2(SO_4)_3$.
FIGURE 4. Palmella and dead cells from $5n/100,000$ $Al_2(NO_3)_6$.
FIGURE 5. Palmella and zoöspores from $n/100,000$ $Al_2(NO_3)_6$.

ious stages.) In weaker concentrations the filaments persist, zoöspore acceleration being still evident in $5n/1,000,000$. In $n/1,000,000$ the culture is normal for a weak solution. Here zoöspores are produced but not as soon nor in such great number as in the stimulated cultures.

2. *Aluminium sulfate* ($Al_2(SO_4)_3$). — This salt acts in the same way as does the nitrate, and at the same concentrations. (See *fig. 3*, showing a large group of palmella still exhibiting traces of

the filamentous form from which it came, and several dead cells with granular remains of others.)

3. Ammonium nitrate (NH_4NO_3). — The killing strength was not determined; it lies above $n/100$. In the last named concentration a large proportion of the cells die, the remainder becoming palmella. The same is true of $n/1,000$ but more cells live. (See *fig. 6*, showing palmella cells arising from cylindrical filamentous ones, by the survival of the most resistant, apparently.) In $5n/$



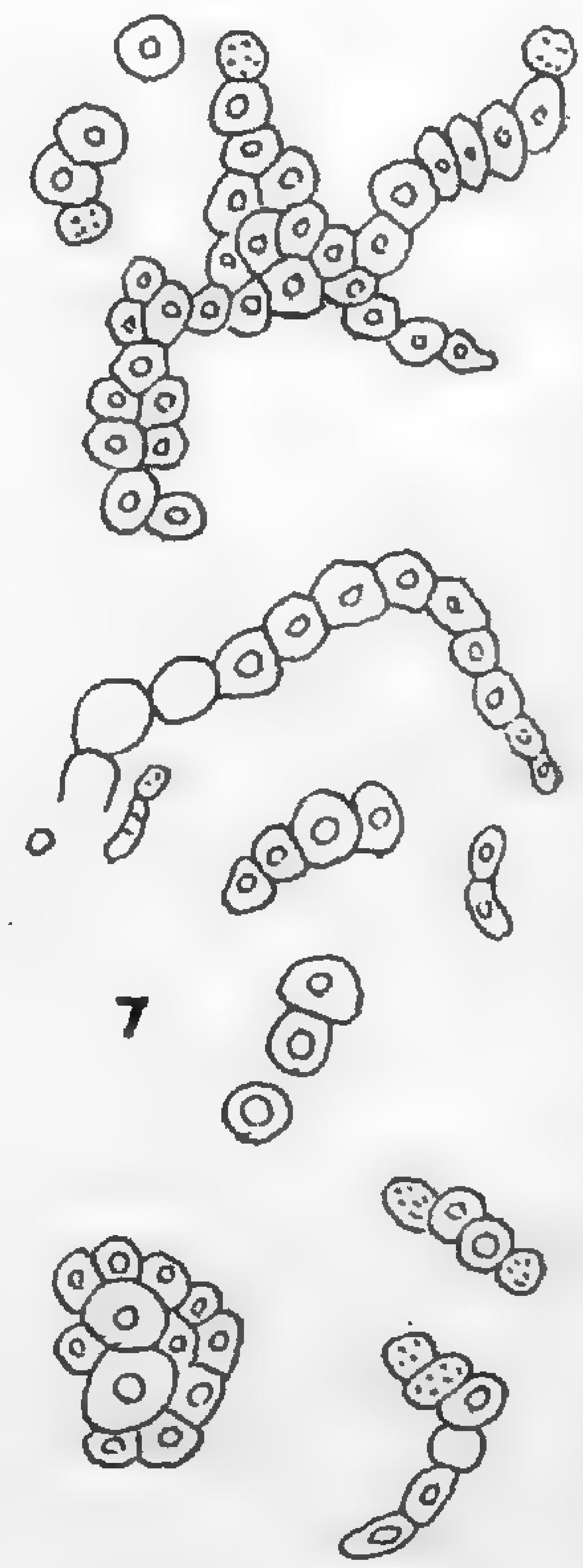


FIGURE 6. Palmella and dead cells from $n/1,000$ NH_4NO_3.

FIGURE 7. Palmella, traces of filaments, sporangia, and zoöspores, from $5n/10,000$ $(NH_4)_2SO_4$.

10,000 and $6n/10,000$, the palmella form is still more or less apparent, though good filaments usually persist. There is in the last named strengths an acceleration of zoöspore production, as in the aluminium salts. At $n/10,000$ all traces of palmella form are lost and the zoöspore activity has sunk to normal, *i. e.*, this strength gives the usual growth for a solution of low osmotic pressure.

4. Ammonium sulfate ($(NH_4)_2SO_4$). — The results are the same as for the nitrate. (*Fig. 7* shows palmella, several fairly typical filamentous cells, and sporangia.)

5. Barium nitrate ($Ba(NO_3)_2$). — With this salt, *n*/100 kills practically all cells, although sometimes a few of the palmella form will survive. The palmella form is typically produced in 5*n*/1,000, and more slowly in *n*/1,000. In 5*n*/1,000 to some extent, but especially in *n*/1,000, there is again an acceleration of zoöspore production, which activity falls back to normal at a concentration of 5*n*/10,000.

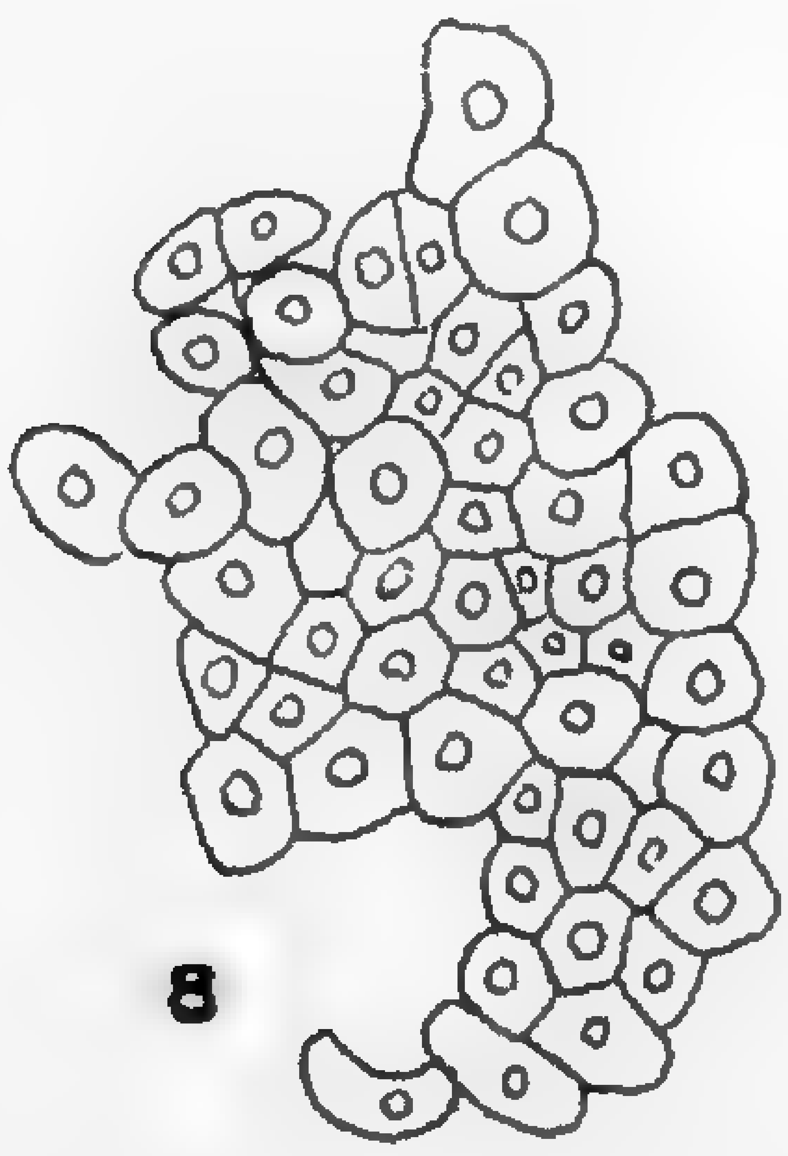
6. Calcium nitrate ($Ca(NO_3)_2$). — This salt is a component of the nutrient solution itself and therefore it is difficult to determine its effect upon the plant without having recourse to other methods than the ones here used. The experiments indicate that it produces palmella at 5*n*/100, and that there is a zoöspore acceleration from *n*/100 to 5*n*/1,000. The palmella response is perhaps partly due to osmotic pressure.

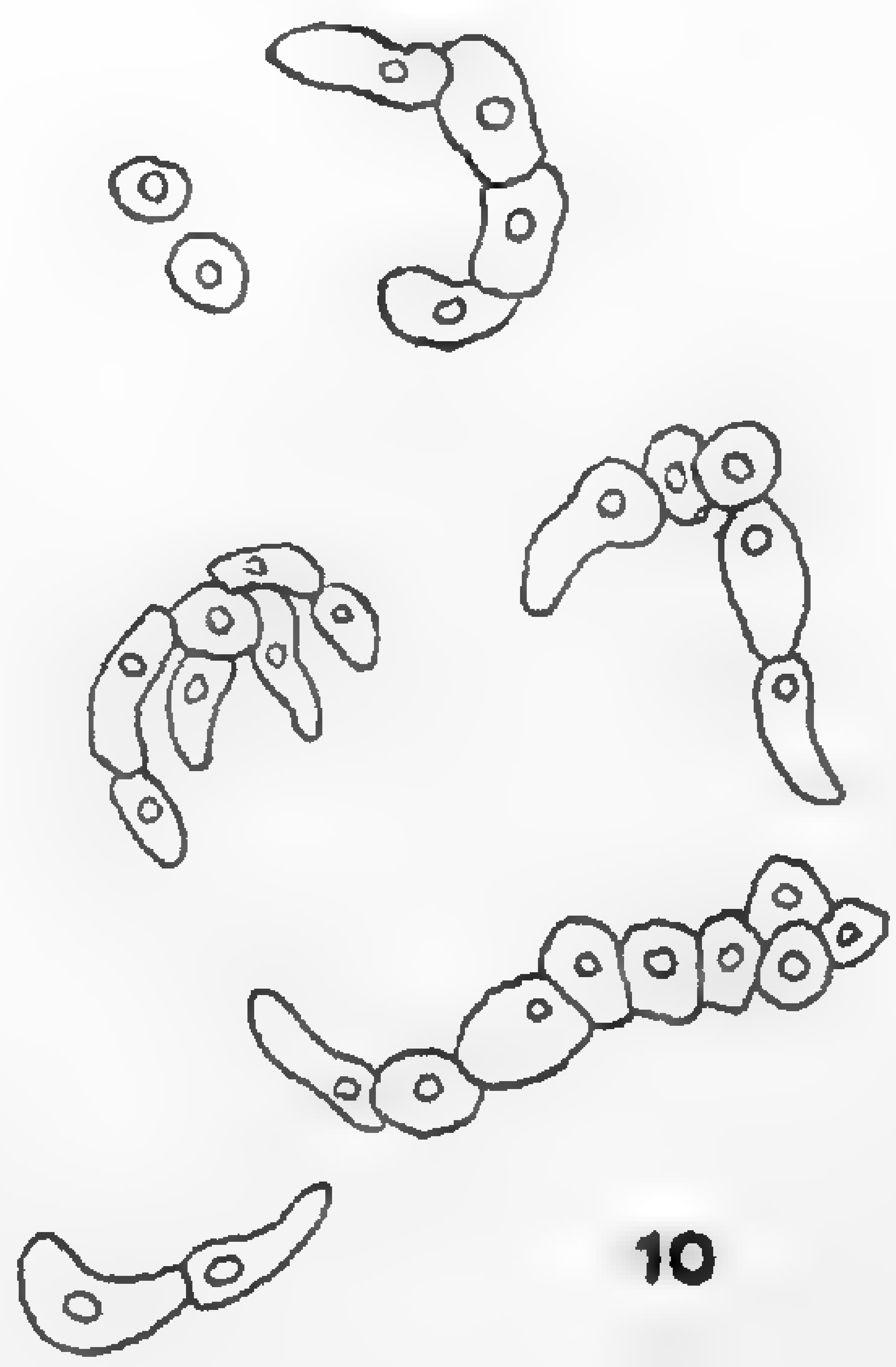
7. Cadmium nitrate ($Cd(NO_3)_2$). — The lowest dilution producing death to all cells is *n*/10,000, usually 5*n*/100,000 kills the majority of the cells. The typical palmella form is produced in concentrations of from 5*n*/100,000 to *n*/100,000, and zoöspore acceleration appears in the latter concentration and continues in weaker ones till the cultures become normal in the vicinity of 5*n*/1,000,000. It is often difficult to tell where acceleration of zoöspore production actually ceases ; the markedly increased activity of the higher concentrations grades almost imperceptibly into the normal production of these bodies in the weaker ones.

8. Cobalt nitrate ($Co(NO_3)_2$). — The killing strength is from *n*/1,000 to 5*n*/10,000. The palmella form is produced in 5*n*/10,000 to *n*/100,000, and zoöspore stimulation at *n*/10,000 to 5*n*/1,000,000, below which concentration the cultures are normal. (*Fig. 8* shows palmella from *n*/10,000 concentration.)

9. Cobalt sulfate ($CoSO_4$). — The responses here follow accurately those with the nitrate. (*Fig. 9* shows palmella in 5*n*/1,000,000, while *fig. 10* shows nearly normal filaments in one-fifth of that strength.)

10. Copper nitrate ($Cu(NO_3)_2$). — The killing strength is from *n*/100,000 to 5*n*/1,000,000. In the latter strength sometimes a few palmella cells remain. Filaments are inhibited, thus giving the palmella form, in strengths from 5*n*/1,000,000 to 5*n*/10,000,000. The palmella form in solutions of this salt is usually somewhat bluish green in color. There is an acceleration of zoöspore production at *n*/1,000,000. At *n*/10,000,000 the culture is normal.





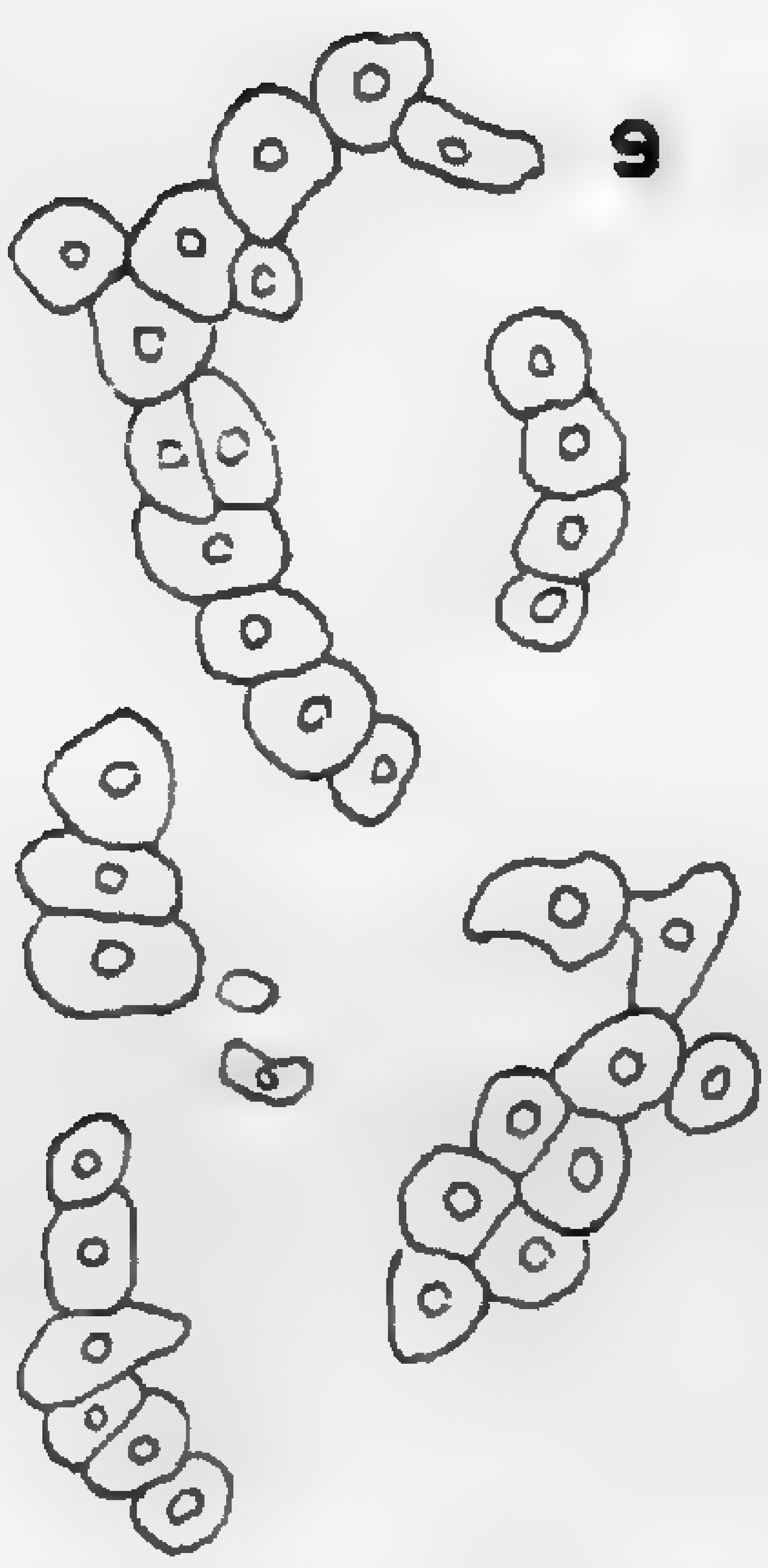


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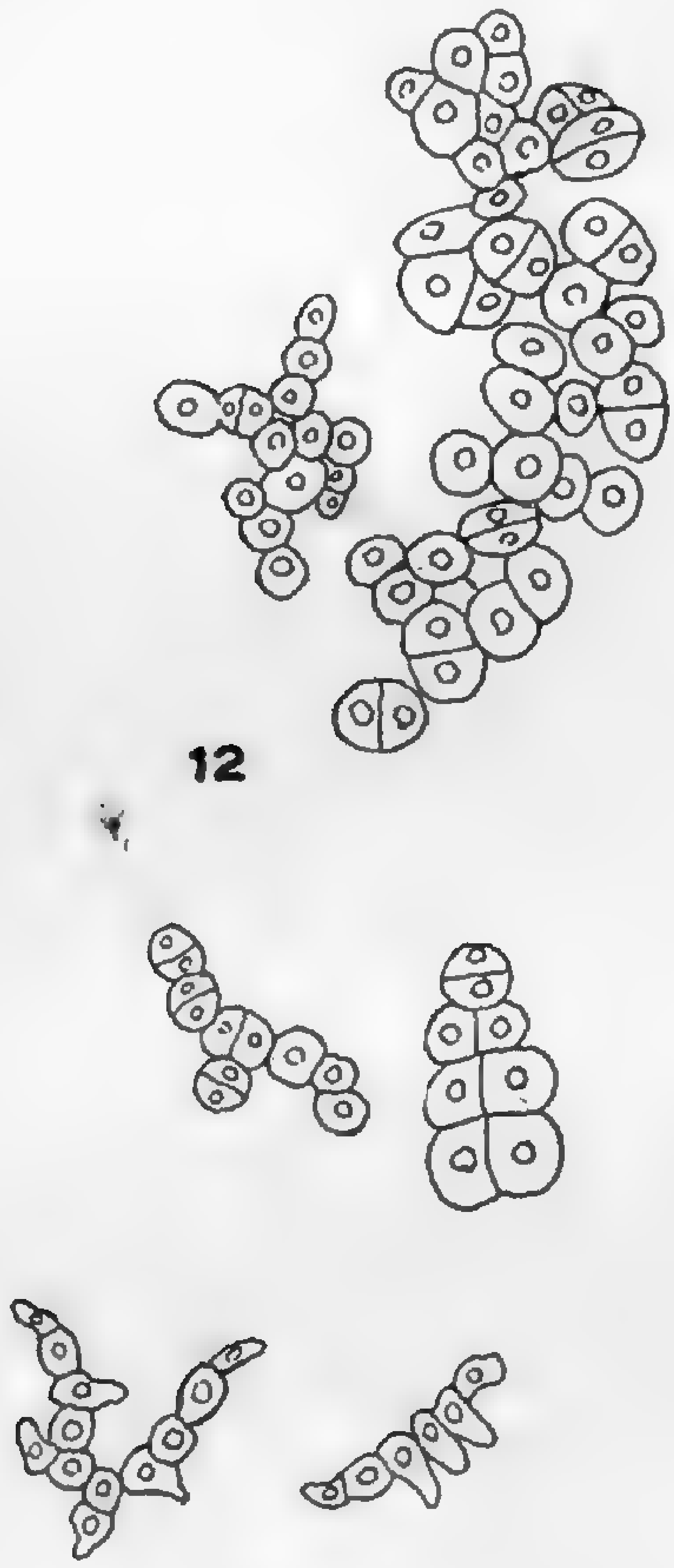
FIGURE 8. Palmella from *n*/10,000 $Co(NO_3)_2$.
FIGURE 9. Palmella and zoöspores from 5*n*/1,000,000 $CoSO_4$.
FIGURE 10. Filaments from *n*/1,000,000 $CoSO_4$.
FIGURE 11. Palmella from *n*/1,000,000 $Cu(NO_3)_2$.

(*Fig. 11* illustrates typical palmella from *n*/1,000,000 concentration.)

11. Copper sulfate ($CuSO_4$). — The sulfate again agrees with the nitrate. (*Fig. 12* shows the appearance of palmella in *n*/1,000,000, concentration.)

12. Hydrogen nitrate, nitric acid (HNO_3). — This body kills the plant at a concentration of 5*n*/10,000. Palmella is produced from *n*/10,000 to 6*n*/100,000, sometimes even in 3*n*/100,000. Acceleration of zoöspore production is exhibited from *n*/100,000 to 6*n*/100,000 or 3*n*/100,000, in certain cases, and below the last-named strength, at least at *n*/100,000, the alga appears normal. (See *fig. 13*, which shows palmella produced from filaments in a solution of 6*n*/100,000 concentration.)



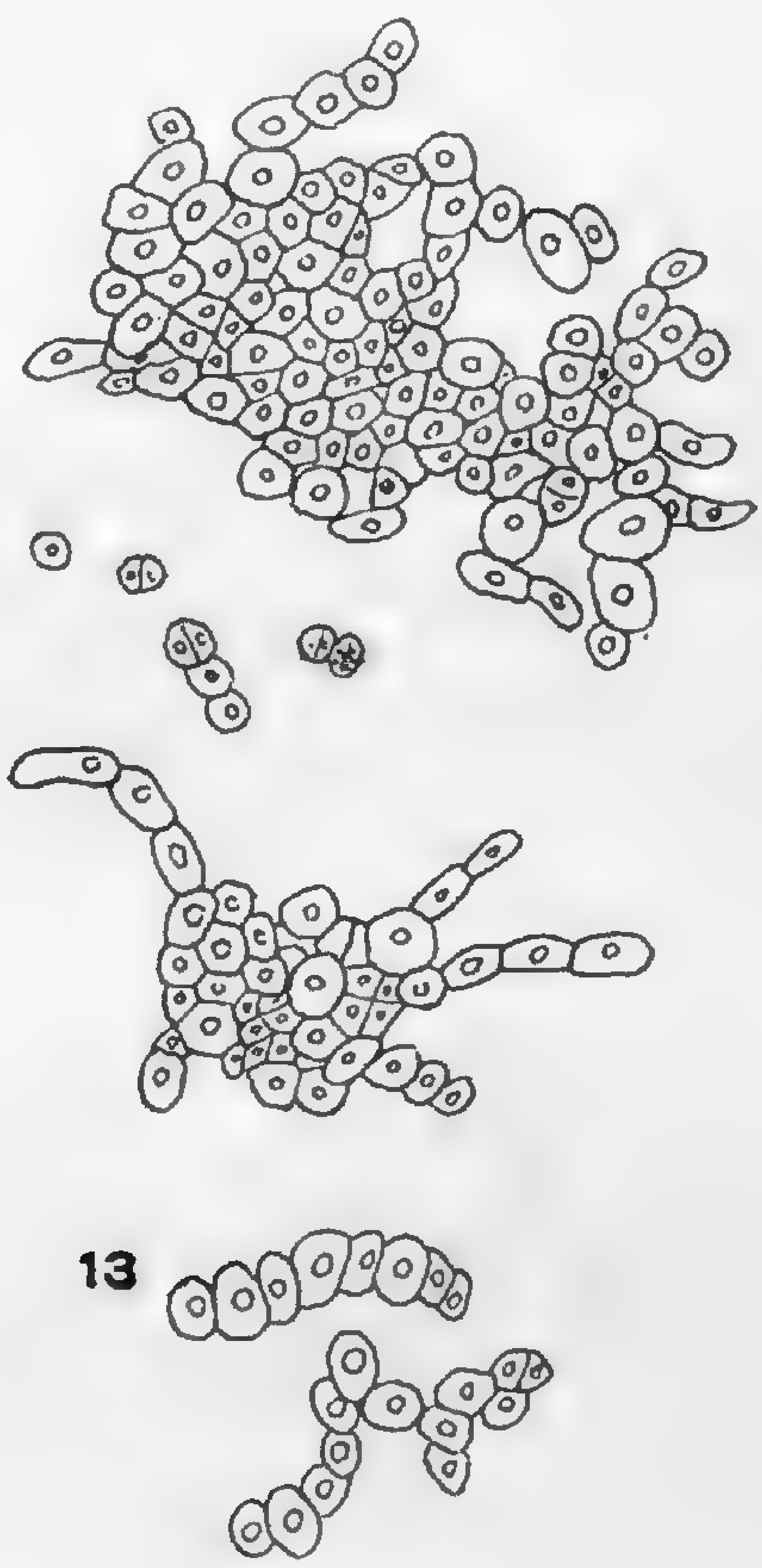


FIGURE 12. Palmella and some filaments changing to palmella, from *n*/1,000,000 $CuSO_4$.

FIGURE 13. Palmella from 6*n*/100,000 HNO_3.

13. Hydrogen sulfate, sulfuric acid (H_2SO_4). — This follows nitric acid very closely. There seems to be here sometimes a tendency for the palmella range to extend downward so to include *n*/100,000, but it was impossible to establish this for a certainty in all series. If it be so, it of course means that the sulfate is somewhat more active than the nitrate, and that the action in this case is not entirely to be attributed to the cation. This would agree with the results of certain other authors to be cited later. (*Fig. 14* shows palmella and dead cells from 3*n*/100,000.)

14. Iron nitrate (*ferric*) ($Fe_2(NO_3)_6$). — The cells are all killed at *n*/10,000. They live as the palmella form in concentrations of from 8*n*/100,000 to 5*n*/100,000. At 7*n*/100,000 and 8*n*/100,000 zoöspore production is accelerated, and at 2*n*/100,000 and *n*/100,000 the growth is normal for weak solutions. For these tests iron was omitted from the nutrient medium to which the poison was added.

15. Lead nitrate ($Pb(NO_3)_2$). — Death ensuses in *n*/10,000. In 5*n*/100,000, the majority of the cells die, but some become of

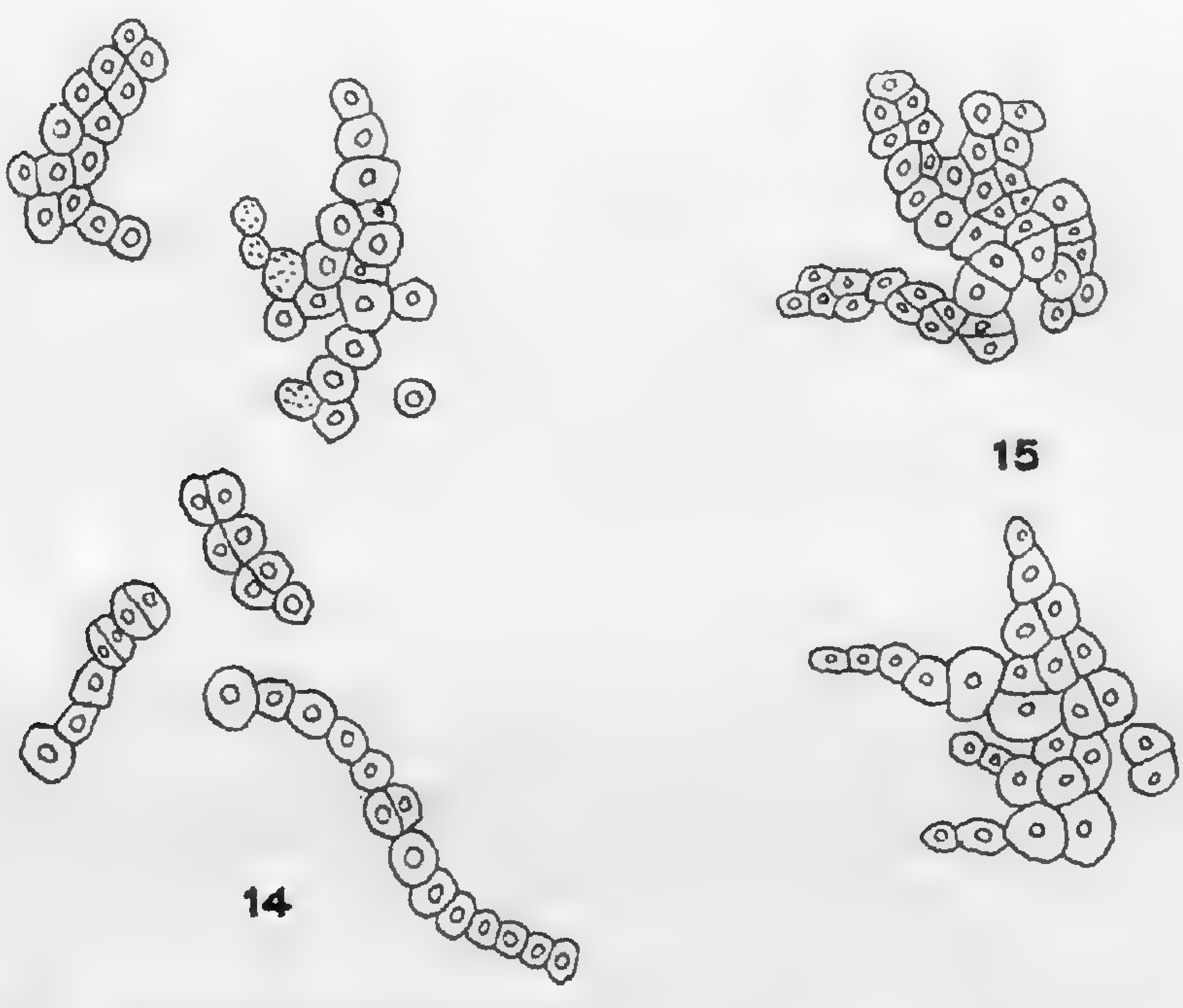


FIGURE 14. Palmella and several dead cells from 3*n*/100,000 H_2SO_4.
FIGURE 15. Palmella from *n*/1,000,000 $AgNO_3$.

the palmella form. The latter form is maintained through the series to 5*n*/1,000,000, in which solution there are usually a number of good filaments, although most of the culture is of spherical cells. Zoöspore acceleration occurs in *n*/100,000 to 5*n*/1,000,000. In *n*/1,000,000 to 5*n*/10,000,000, the growth of filaments and zoöspores is the same as in the control.

16. Lithium nitrate ($LiNO_3$). — Many, but not all, of the cells die in 5*n*/100. The palmella form is produced from 5*n*/100 to

5*n*/10,000, with some acceleration of zoöspore production in *n*/1,000 to 5*n*/10,000. The acceleration is not as marked as in most of the other salts, however. Normal growth occurs in *n*/10,000 and weaker solutions.

17. Lithium sulfate (Li_2SO_4). — A thorough test of this salt was not made, but as far as the experiments were carried the results agree well with the data given for the nitrate.

18. Magnesium nitrate ($Mg(NO_3)_2$). — This cation is present in the nutrient medium. The experiments consisted in increasing its amount. 5*n*/100 does not kill, but produces the palmella form as does also *n*/100 and, to some extent, 5*n*/1000. Zoöspore acceleration occurs in *n*/100 and the normal behavior is exhibited in *n*/1,000 and still weaker solutions.

19. Magnesium sulfate ($MgSO_4$). — This salt agrees with the nitrate perfectly excepting that it was impossible to establish a true zoöspore acceleration here. Sometimes this phenomenon appears and at other times not. It appeared most often at *n*/100 concentration. Perhaps undissociated molecules have to do with this response, but no particular study was made here, this subject lying rather in the field of nutrient salts than in that of toxic ions.

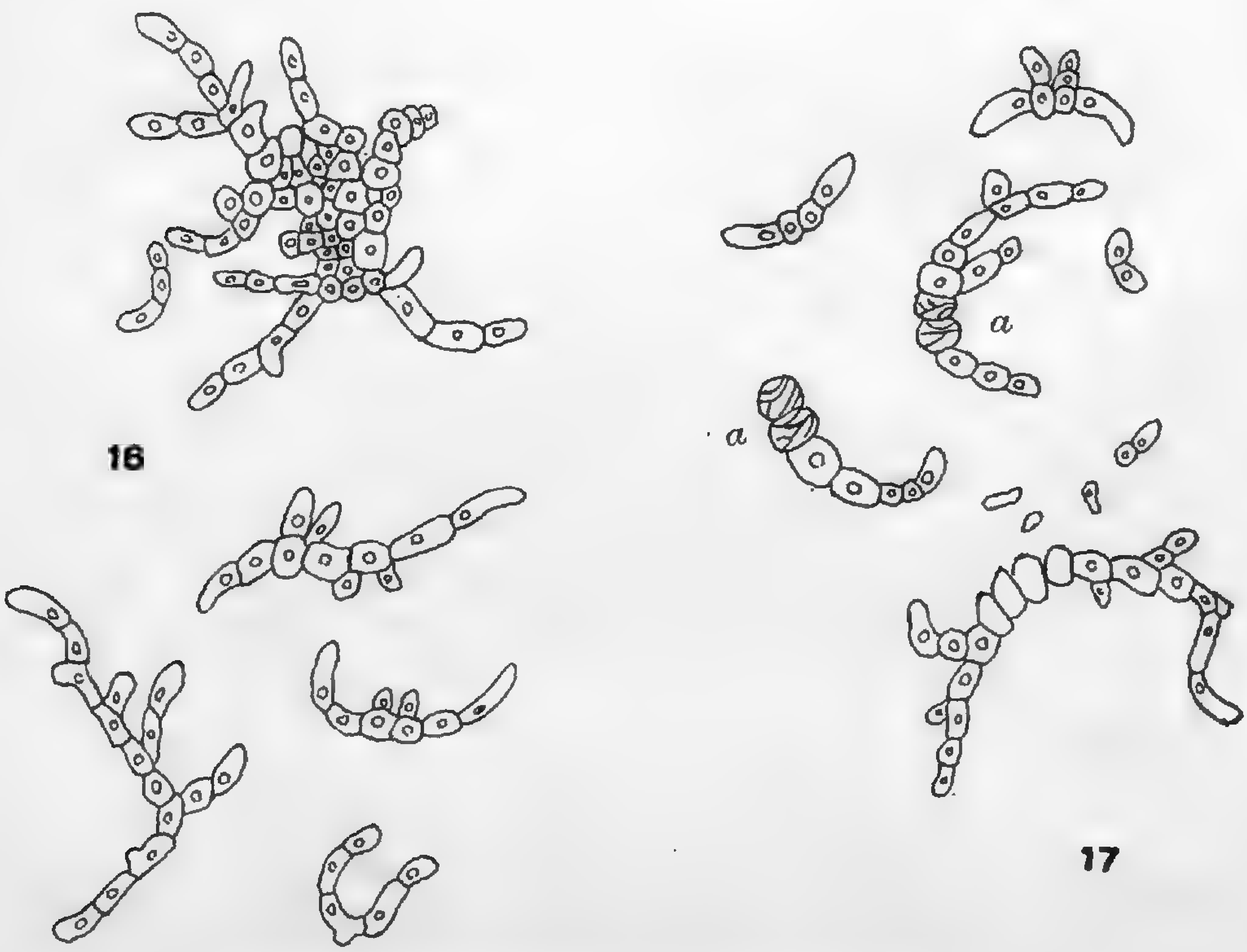
20. Nickel nitrate ($Ni(NO_3)_2$). — A concentration of *n*/10,000 produces death. Filaments are hardly at all present in 5*n*/100,000, practically all of the cells being of the other form, but in *n*/100,000 there is about an even mixture of the two forms. A rather slightly marked zoöspore acceleration occurs in *n*/100,000, and still less marked in weaker solutions. At a concentration of *n*/10,000,000 the alga is certainly uninfluenced by the poison. The zoöspore acceleration grades almost imperceptibly into the normal production of these bodies.

21. Potassium nitrate (KNO_3). — This salt is so common in the environment of plants that it would hardly be expected to produce very marked stimulation responses. It is probably less toxic toward plants in general than any other salt. At a concentration of 5*n*/100 the palmella form is produced. This is perhaps due, in part at least, to osmotic phenomena. No acceleration of zoöspore production was observed.

22. Potassium sulfate (K_2SO_4). — As far as could be determined, this salt acts exactly like the nitrate.

23. Rubidium sulfate (Rb_2SO_4). — The plant is killed by $n/100$ and to some extent by $5n/1,000$. In $5n/1,000$ and $n/1,000$ the palmella form is produced, with few or no zoospores, and the culture becomes normal at $n/10,000$. No acceleration of zoöspore production occurs here.

24. Silver nitrate ($AgNO_3$). — Death occurs from $n/100,000$ to $6n/1,000,000$. Filaments do not appear in $n/1,000,000$, but begin to survive in $5n/10,000,000$, where also there is an increase



16

17

FIGURE 16. Palmella and filaments from $5n/10,000,000$ $AgNO_3$.
FIGURE 17. Normal filaments and zoösporangia (*a*), from $n/10,000,000$ $AgNO_3$.

in the number of zoöspores. The cultures are normal or slightly accelerated as to zoöspore activity, in $n/10,000,000$. (See *figs. 15, 16,* and *17.* The former shows typical palmella form in $n/1,000,000$, the second a mixture of palmella and filamentous forms in $5n/10,000,000$, and the last a normal filamentous culture in $n/10,000,000$. Zoösporangia are shown at *a.*) The limits are quite sharply defined for this salt.

25. Sodium nitrate ($NaNO_3$). — This cation is but little more poisonous than potassium. The palmella form is produced in

5*n*/100 to *n*/100, with filaments also quite well developed in the last-named strength. Osmotic pressure probably begins to play some part here. The killing concentration was not determined. There is little if any acceleration of zoöspore production. Cultures appear normal in *n*/1,000.

26. *Sodium sulfate* (Na_2SO_4). — This follows the last-named salt accurately as far as was determined.

27. *Strontium nitrate* ($Sr(NO_3)_2$). — This cation is very slightly toxic, so that here again osmotic phenomena begin to play a part before a stimulating concentration is reached. The killing strength was not determined. The palmella form is produced typically in 5*n*/100, and there is unquestionably an acceleration in zoöspore production in 5*n*/1,000, in which the zoöspores develop into short filaments but are destroyed rapidly by the formation of zoösporangia. The cultures are normal at *n*/1,000 and below.

28. *Uranyl nitrate* ($UO_2(NO_3)_2$). — Death occurs here in *n*/10,000 or stronger, the spherical form appears in 5*n*/100,000 and is found mixed with filaments in *n*/100,000. Acceleration of zoöspore production is exhibited in *n*/100,000 and in 5*n*/1,000,000, while normal growth occurs in *n*/1,000,000 and below.

29. *Zinc nitrate* ($Zn\ (NO_3)_2$). — In 5*n*/10,000 death ensues, in *n*/10,000 about one half of the cells die, the rest take the palmella form. In 5*n*/100,000 both filaments and palmella occur and zoöspores are more numerous than in the control, while in *n*/100 growth is the same as in the control.

30. *Zinc sulfate* ($Zn\ SO_4$). —The sulfate of this metal acts like the nitrate, excepting that here again an acceleration of zoöspore activity could not be established.

These results will now be brought together in tabular form. In the table which follows, the salts are arranged in the same order as in the foregoing description. In the first column after the name of the salt, occurs the lowest concentration producing death. In the second column are placed the concentrations at which filaments change to the other form. The strengths at which zoöspore production is accelerated are shown in column four, and that at which growth becomes normal is expressed in the last column.

TABLE OF RESULTS

Salt.	Lowest fatal concentration.	Filaments become palmella.	Acceleration of zoöspore production.	Normal filaments.
$Al_2(NO_3)_6$	n/10,000	5n/100,000 n/100,000	n/100,000 5n/1,000,000	n/1,000,000
$Al_2(SO_4)_3$	"	"	"	"
NH_4NO_3	?	n/100 5n/10,000	5n/10,000 6n/10,000	n/10,000
$(NH_4)_2SO_4$	?	"	"	"
$Ba(NO_3)_2$	n/100	5n/1,000 n/1,000	5n/1,000 n/1,000	5n/10,000
$Ca(NO_3)_2$	?	5n/100	n/100 5n/1,000	?
$Cd(NO_3)_2$	n/10,000	5n/100,000 n/100,000	n/100,000	5n/1,000,000
$Co(NO_3)_2$	n/1,000	5n/10,000 n/100,000	n/10,000 5n/1,000,000	n/1,000,000
$CoSO_4$	"	"	"	"
$Cu(NO_3)_2$	n/100,000	5n/1,000,000 5n/10,000,000	n/1,000,000	n/10,000.000
$CuSO_4$	"	"	"	"
HNO_3	5n/10,000	n/10,000 6n/100,000	n/100,000 6n/100,000	n/100,000
H_2SO_4	"	n/10,000 n/100,000 (?)	"	"
$Fe_2(NO_3)_6$	n/10,000	8n/100,000 5n/100,000	7n/100,000 8n/100,000	2n/100,000
$Pb(NO_3)_2$	n/10,000	5n/100,000 5n/1,000,000	n/100,000 5n/1,000,000	n/1,000,000
$LiNO_3$	?	5n/100 5n/10,000	n/1,000 5n/10,000 (slight)	n/10,000
Li_2SO_4	?	"	"	"
$Mg(NO_3)_2$	?	5n/100 n/100	n/100	n/1,000
$MgSO_4$	?	"	n/100 (?)	"
$Ni(NO_3)_2$	n/10,000	5n/100,000	n/100,000	n/10,000,000
KNO_3	?	5n/100	No acceleration.	?
K_2SO_4	?	"	No acceleration.	?
Rb_2SO_4	n/100	5n/1,000 n/1,000	No acceleration.	n/10,000
$AgNO_3$	n/100,000	6n/1,000,000 5n/10,000,000	5n/10,000,000	n/10,000,000
$NaNO_3$	?	5n/100 n/100	No acceleration.	n/1,000
Na_2SO_4	?	"	No acceleration.	"
$Sr(NO_3)_2$	?	5n/100	5n/1,000	n/1,000
$UO_2(NO_3)_2$	n/10,000	5n/100,000 n/100,000	n/100,000 5n/1,000,000	n/1,000,000
$Zn(NO_3)_2$	5n/10,000	n/10,000	5n/100,000	n/100,000
$ZnSO_4$	"	"	?	"

From the above statement of responses, it will readily be seen that the action of sulfate and nitrate is the same in practically all cases. This means, of course, that according to the dissociation hypothesis, the anions are comparatively without effect and that the responses just described are due to the presence of the metal ions in the medium. This is what should be expected from the fact that in the case of all the more poisonous salts the difference between experiment and control in concentration of the SO_4 or NO_3 ions is negligible. As has been said, these anions were chosen because they were already present in the nutrient medium. They are two out of the three which the plant uses most extensively in its metabolism, and thus it is not surprising that its protoplasmic system is of such a nature that slight, or even rather great, changes in their concentration are without visible effect upon the life-process. It will be remembered in this regard that it was shown in a previous paper * that a decrease to one-tenth its normal amount of any one of the nutrient salts used in Knop's solution is without effect upon this plant, so long as the osmotic properties of the solution are not altered by the change.

In order to study the question of the relation of stimulating power to the other properties of the metals studied, the following two lists were constructed. One is based on the lowest fatal concentrations, the other on the lowest concentration producing the palmella form. In the first column of each list is given the symbol of the cation (since anions play no part, they need not be considered), and in the second the concentration with regard to which the list is made. The elements are arranged in the order of their stimulating power, the weakest ones first. In cases where the least fatal concentration could not be determined with sharpness but where there are indications as to its position, slightly above or below the concentration given, the signs + and – are used to denote "greater than" and "less than." Where the sign is double it denotes "much greater than."

These lists are presented here in order to have the varying degrees of toxicity or stimulating power in mind before taking up the discussion of the three forms of response mentioned in a pre-

* Livingston, B. E. On the nature of the stimulus which causes the change in form in polymorphic green algae. Bot. Gaz. 30: 289-317. 1900.

ceding paragraph. These three responses will now be considered under the three heads: (1) The response of death, (2) The response in phenomena of growth, and (3) The response in reproduction.

List of cations according to lowest fatal concentration.

Element.	Concentration in Terms of *n*
Ca	5/100 ++
Mg	5/100 ++
K	5/100 ++
Na	5/100 ++
Sr	5/100 ++
Li	5/100 +
NH_4	1/100 +
Ba	1/100 +
Rb	1/100 —
Co	1/1,000
H	5/10,000
Zn	5/10,000 —
Fe	1/10,000
Ni	1/10,000
U	1/10,000
Al	1/10,000 —
Cd	1/10,000 —
Pb	1/10,000 —
Cu	1/100,000
Ag	1/100,000

List of cations according to the lowest concentration producing palmella form.

Element.	Concentration in Terms of *n*
Ca	5/100
K	5/100
Sr	5/100
Mg	1/100
Na	1/100
Ba	1/1,000
Rb	1/1,000
NH_4	5/10,000
Li	5/10,000
Zn	1/10,000
H	6/100,000
Fe	5/100,000
Ni	5/100,000
Al	1/100,000
Cd	1/100,000
Co	1/100,000
U	1/100,000
Pb	5/1,000,000
Cu	5/10,000,000
Ag	5/10,000,000

III. DISCUSSION OF RESPONSES. 1. *The response of death.* — As has been stated, death must be considered as truly a response to stimuli as are any of the other alterations commonly passing under that name. Whatever may be the ultimate nature of the vital processes, they continue in such manner as to make up what is called life only while variation of the conditions external to the organism takes place within certain more or less narrow limits. Within these limits, changes of environment produce changes in the vital processes, and hence obvious changes in form, structure, and activity of the organism as a whole. Beyond them the necessary equilibrium of the many-sided system fails, and vitality ceases. Thus, the least concentration producing death may fairly be regarded as a criterion for estimating the stimulating power of any substance. The criterion for judging whether or not this plant is living is based on its loss of green color soon after death occurs.

No doubt all the salts tested here would produce death at *some* concentration, but those whose stimulating power or toxicity is weakest do not bring about this response until their concentration is high enough so that the osmotic pressure of the solution may begin to play its rôle. The cations Ca, Li, Mg, K, Na and Sr belong to this class, as do also probably NH_4, Ba, and perhaps Rb. The toxicity of these elements cannot be studied in a nutrient medium of as low pressure as the one here used. Perhaps it is impossible to determine it for the filamentous form of this plant.

What may be the nature of the killing power of the elements for which this property was determined is difficult to conjecture without more data. It is instructive to note, at any rate, that their effect in this regard is exactly similar to that of a drying medium. We see the same sort of death phenomena in these poisoned solutions of low osmotic pressure that was found for solutions of high pressure. In very strong solutions the cells die as filaments, in somewhat weaker ones they round off and assume the palmella form before death ensues. The relation of this toxicity to the physico-chemical nature of the elements will be considered in a later paragraph.

2. *The response in phenomena of growth.* — All of the elements tested produce the palmella response at some concentration. In case of Ca, K and Sr and perhaps of Mg and Na, this response may be in part due to osmotic pressure. For the other cations there can be no doubt that it is purely a chemical stimulus which is acting. The fact to be emphasized here again is that we have exactly the same growth changes brought about by the presence of toxic cations as are produced by physical extraction of water. In the poisoned cultures (whose osmotic pressure, it is to be remembered, is very low, much lower than is necessary for the retention of the filamentous form in an unpoisoned nutrient medium), there are observed exactly the same rounding up of cells, the same thickening of walls, and the same alteration in rapidity and direction of cell-division, as was found to take place when filaments are converted to the other form by the action of a concentrated solution.

These observations agree with those of the death responses, and it seems possible that in both cases we have to deal with a change in the water-content of the protoplasm. In the case of solutions of high osmotic pressure, water is extracted from the protoplasm directly, and it may be that this increasing density of the colloidal protoplasmic solution is accompanied by changes in its permeability to solute and in its general lability, and therefore chemical activity, which result in a higher osmotic pressure within the vacuole. I have been able to demonstrate this higher pressure by the plasmolytic method in cells of the palmella form. This higher osmotic pressure, as has been shown (*loc. cit.*, 1900), will suffice to explain the change in form of the cells and their partial or complete separation as they become spherical. A decrease in lability, and hence in general activity, may result in the observed thickening of the wall and in a change in the manner of cell-division, as is known to be the case in many plant and animal tissues under the influence of dryness and low temperature, where these are unquestionably concomitants of a decrease in the intensity of vital action.

But in case of toxic stimulation, with which this paper has to deal, there is no direct extraction or witholding of water from the cell, and by the principles of physics alone we are unable to see any difference between the poisoned and the unpoisoned nutrient medium. However, it is possible that the chemical stimulus of the toxic ions may be transformed, as the disturbance of the system passes within the limits of the protoplasm, and may become in this way a physical disturbance. It is well known that certain mineral salts hasten the coagulation of some proteids and other colloidal solutions,* and it is quite reasonable to suppose that the toxic ions upon entering the protoplasmic mass may produce in this vital hydrosol mixture an incipient coagulation or tendency toward the gel phase. If this were true it would mean that the colloidal particles become aggregated to some extent into denser masses, between and around which would lie a solution of less density, which would contain fewer colloidal particles than before. Thus, although by this supposed process of incipient coagulation water is not extracted from the protoplasmic solution as a whole, yet it is extracted from *certain parts* of this solution, namely from

* See Whetham, W. C. D. The coagulative power of electrolytes. Phil. Mag. V. 48 : 474–477. 1899.

the partially coagulated groups or masses of colloidal particles. And if, as is probable, the seat of vital activity lies in the colloidal portion of the protoplasm rather than in the permeating aqueous solution, it becomes possible to see how an incipient production of the hydrogel phase in certain regions throughout the protoplasm may result in the same sort of alterations in permeability and lability as those brought about by general extraction of water with its accompanying increase in density of the vital substance. In brief, the suggestion here put forward is, that toxic ions may virtually bring about an extraction of water from the vital portions of the protoplasmic mass, and that this may result in the same obvious and tangible responses as those caused by direct extraction of water from the whole mass. Before this suggestion can be taken seriously it will be necessary to know more of the influence of ions upon colloidal solutions.

Another possibility, closely related to the one just presented, is that the toxic cations may act upon the enzymes of the vital substance in such a manner as to bring about the changes noted. Indeed, the alteration of enzyme action (which appears in these days to have come to mean much the same as vital action, at least to play the leading part in our conception of the latter) may well be the common effect of water extraction and the entrance of poison cations into the living substance. Both suggestions are thus seen to be possible at the same time, the latter becoming a part of the former. The probability of the last idea, can be judged best only after more data have been obtained on the effect of poisons upon enzyme action, which work has happily already begun. *

* See the following papers on this subject:

Zoethout, W. D. On the production of contact irritability without the precipitation of Ca salts. Am. Jour. Physiol. 10 : 324–334. 1904.— Further experiments on the influence of various electrolytes upon the tone of skeletal muscles. Am. Jour. Physiol. 10 : 373–377. 1904.

Brown, O. H. Effects of certain salts on kidney excretion with especial reference to glycosuria. Am. Jour. Physiol. 10 : 378–383. 1904.

Neilson, C. H. & Brown, O. H. Effect of ions on decomposition of hydrogen peroxide and hydrolysis of butyric ether by watery extracts of pancreas. Am. Jour. Physiol. 10 : 335–344. 1904.—Effects of ions on decomposition of hydrogen peroxide by platinum black. Am. Jour. Physiol. 10 : 225–228. 1904.

Neilson, C. H. The hydrolysis and synthesis of fats by platinum black. Am. Jour. Physiol. 10 : 191–200. 1903.

McGuigan, H. Relation between decomposition tension of salts and their antifermentative properties. Am. Jour. Physiol. 10 : 444–451. 1904.

3. The response in phenomena of reproduction. — With most of the cations studied there is a curious difference between the effect of drying solutions (of high pressure) and poisoned ones. This lies in the observed fact that in the latter zoöspore production may not only be as active as in the unpoisoned control, but that it may be much more active, while in the former zoöspore production is entirely inhibited. Thus extraction of water produces the palmella form and inhibits zoöspores, while the presence of toxic cations produces the palmella form, but also, at some concentration, generally accelerates the production of zoöspores. This would seem to prove that the relation between the two sets of responses is not as simple as might otherwise be supposed. It seems possible that the production of zoöspores is due to a somewhat different set of changes in the protoplasm from those involved in ordinary growth, a set of changes which may be started by several apparently different external factors. The phenomena of reproduction lie at present so much within the province of the unknown that it would probably be unprofitable to attempt any hypothesis in this regard. Attention may be called here, however, to the fact that there are fairly well-known activities taking place simultaneously within plant protoplasm, and yet controlled by entirely different sets of factors. As examples may be mentioned the processes of photosynthesis and respiration.

The fact that the acceleration here held in view is not observed in case of the cations, K, Rb, and Na, and is somewhat questionable in that of Li and Mg, together with the fact that these elements are among the least toxic, seems to show that there is some sort of a relation between the responses of death and change in growth, on the one hand, and of reproduction on the other. This matter of stimulation of reproductive activity may be a fertile field for further investigation.

Lillie, R. S. Relation of ions to ciliary movement. Am. Jour. Physiol. **10**: 419–443. 1904.

Mathews, A. P. The nature of chemical and electrical stimulation. I. The physiological action of ions depends on electrical state and electrical stability. Am. Jour. Physiol. **11**: 445–496. 1904.

Cole, S. W. Contributions to our knowledge of enzyme action. I. Influence of electrolytes on action of amylolytic ferments. Jour. Physiol. **30**: 202–220. 1903. — Contributions to our knowledge of enzyme action. II. Influence of electrolytes on the action of invertin. Jour. Physiol. **30**: 281–289. 1903.

LITERATURE

In any consideration of the general relation of the properties of reagents to those of responding organisms, it is essential to have a considerable mass of data from different forms of the latter. It is also desirable, of course, to know the relative stimulating or toxic power of as many elements as possible upon the same organism. The literature contains a respectable number of titles dealing with the question before us, but unfortunately the majority of the determinations have been made in such a manner as to render them quite inadequate for the present purpose. The work that has been done on plants has been briefly summarized, up to the time of his publication, by Copeland,* and a more recent review of certain phases of the subject comes from the hand of Benecke.† Observations which have an immediate relation to the results here presented will be stated briefly in the following paragraphs.

Acceleration of growth in *Aspergillus* and *Penicillium* was studied by Richards,‡ and in part corroborated by Miss Watterson.§ For the former of these fungi $ZnSO_4$ accelerates growth most at concentrations of 0.002 per cent. ($6n/100,000$) to 0.004 per cent. ($12n/100,000$). The salt is harmful at concentrations from 0.05 per cent. ($16n/10,000$) to 0.075 per cent. ($24n/1,000$). $FeSO_4$ accelerates growth a little at 0.2 per cent. ($26n/1,000$), and the culture is normal at 0.033 per cent. ($44n/10,000$). $CoSO_4$ accelerates both fungi most at 0.002 per cent. ($26n/100,000$), while $NiSO_4$ shows the same response at 0.003 per cent. ($85n/100,000$). I have translated the percentage figures approximately into terms of a normal solution, and placed them in the parenthesis which follows each figure.

Ono || worked with both algae and fungi. His results may be

* Copeland, E. B. Chemical stimulation and the evolution of carbon dioxid. Bot. Gaz. **35**: 81–98, 160–183. 1903.

† Benecke, W. Einige neuere Untersuchungen über den Einfluss von Mineralsalzen auf Organismen. Bot. Zeitung **62**²: 113–126. 1904.

‡ Richards, H. M. Die Beeinflussung des Wachsthums einiger Pilze durch chemische Reize. Jahrb. Wiss. Bot. **30**: 665–679. 1897.

§ Watterson, A. The effect of chemical irritation on the respiration of fungi. Bull. Torrey Club **31**: 291–303. 1904.

|| Ono, N. Ueber die Wachsthumsbeschleunigung einiger Algen und Pilze durch chemische Reize. Jour. Coll. Sci. Imp. Univ. Tokyo **13**: 141–186. 1900. Also Bot. Mag. Tokyo, **14**: 75. 1900.

tabulated as follows. Underneath his molecular concentrations I have placed the equivalent strength in terms of normal.

TABLE OF RESULTS OBTAINED BY ONO

Subject.	Salt.	Concentration for acceleration of vegetative growth.	Injurious concentration.	Normal growth.
Protococcus.	$ZnSO_4$	$\frac{1}{2}\ 10^{-6}m$ — $10^{-5}m$ $25n/100,000,000$ — $5n/1,000,000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1,000,000$	
	$CoSO_4$	$\frac{1}{25}\ 10^{-5}m$ — $10^{-5}m$ $2n/1,000,000$ — $5n/1,000,000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1,000,000$	
	$HgCl_2$	No acceleration.	$\frac{1}{25}\ 10^{-5}m$ $2n/10,000,000$	
	NaF	$\frac{1}{125}\ 10^{-3}m$ — $\frac{1}{5}\ 10^{-3}m$ $8n/1,000,000$ — $4n/10,000$	$10^{-3}m$ $n/1,000$	
	$LiNO_3$	$\frac{1}{25}\ 10^{-4}m$ — $10^{-4}m$ $4n/1,000,000$ — $n/10,000$	$\frac{1}{2}\ 10^{-3}m$ $5n/10,000$	
	K_3AsO_4	$\frac{1}{125}\ 10^{-4}m$ — $\frac{1}{25}\ 10^{-4}m$ $26n/100,000,000$ — $13n/10,000,000$	$10^{-4}m$ $33n/1,000,000$	$\frac{1}{5}\ 10^{-4}m$ $66n/10,000,000$
Chroococcum.	$ZnSO_4$	$\frac{1}{25}\ 10^{-5}m$ — $10^{-5}m$ $2n/10,000,000$ — $5n/1,000,000$		$\frac{1}{2}\ 10^{-4}m$ $25n/1,000,000$
	$CuSO_4$	No acceleration.	$\frac{1}{5}\ 10^{-5}m$ $n/1,000,000$	$\frac{1}{25}\ 10^{-5}m$ $2n/10,000,000$
Hormidium.	$FeSO_4$	$\frac{1}{25}\ 10^{-4}m$ — $\frac{1}{2}\ 10^{-3}m$ $2n/1,000,000$ — $25n/100,000$		
	$NiSO_4$	$\frac{1}{25}\ 10^{-5}m$ — $\frac{1}{5}\ 10^{-4}m$ $2n/10,000,000$ — $n/100,000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1,000,000$	$10^{-5}m$ $5n/1,000,000$
	$CoSO_4$	$\frac{1}{25}\ 10^{-5}m$ $2n/10,000,000$	$\frac{1}{5}\ 10^{-5}m$ $n/1,000,000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1,000,000$
Stigeoclonium.	$CuSO_4$	No acceleration.	$\frac{1}{5}\ 10^{-5}m$ — $\frac{1}{25}\ 10^{-5}m$ $n/1,000,000$ — $2n/10,000,000$	
Aspergillus.	$ZnSO_4$	$\frac{1}{8}\ 10^{-3}m$ — $10^{-3}m$ $6n/100,000$ — $5n/10,000$		
	$NiSO_4$	$\frac{1}{8}\ 10^{-3}m$ — $10^{-3}m$ $6n/100,000$ — $5n/10,000$		
	$CoSO_4$	$\frac{1}{16}\ 10^{-3}m$ — $\frac{1}{2}\ 10^{-3}m$ $3n/100,000$ — $25n/100,000$		
	$CuSO_4$	$\frac{1}{16}\ 10^{-3}m$ — $\frac{1}{2}\ 10^{-3}m$ $3n/100,000$ — $25n/100,000$		
	$HgCl_2$	$\frac{1}{8}\ 10^{-4}m$ — $\frac{1}{16}\ 10^{-3}m$ $6n/1,000,000$ — $3n/100,000$	$\frac{1}{8}\ 10^{-3}m$ $3n/100,000$	
	$LiNO_3$	$\frac{1}{16}\ 10^{-2}m$ — $\frac{1}{2}\ 10^{-2}m$ $6n/10,000$ — $5n/100$		
	NaF	$\frac{1}{16}\ 10^{-2}m$ — $\frac{1}{8}\ 10^{-2}m$ $6n/10,000$ — $125n/100,000$	$\frac{1}{2}\ 10^{-2}m$ $5n/100$	$\frac{1}{4}\ 10^{-2}m$ $25n/10,000$
Penicillium.	$FeSO_4$	$\frac{1}{4}\ 10^{-3}m$ — $\frac{1}{2}\ 10^{-3}m$ $125n/1,000,000$ — $25n/100,000$	$2 \times 10^{-3}m$ $n/1,000$	$10^{-3}m$ $5n/100$
	$CoSO_4$	$\frac{1}{16}\ 10^{-3}m$ — $\frac{1}{2}\ 10^{-3}m$ $3n/100,000$ — $25n/100,000$		
	$HgCl_2$	$\frac{1}{16}\ 10^{-3}m$ — $\frac{1}{2}\ 10^{-3}m$ $3n/100,000$ — $25n/100,000$		

This author observed no acceleration in reproductive activity. The accelerations which he noted, — and they occurred for algae with all salts excepting $AgCl_2$ and $CuSO_4$, and with all salts tried for fungi,— always consisted in a hastening of the growth rate, thus giving weight of yield greater than that of the control. His form of *Stigeoclonium* was different from mine. Nothing is said about its being polymorphic, while with my form the important responses are all those which are bound up in the physiology of polymorphism. This difference in the response of acceleration would seem to indicate that even the most nearly related organisms may react differently towards the same stimuli. The concentration limits were not determined sharply enough to make any rigid comparison of these profitable. As far as comparison can be made the results of my experiments seem to agree in a general way with those obtained by Ono.

Richter * was unable to get an acceleration of growth in *Aspergillus* with Cu although he obtained this response with Zn. It may be that in these lower forms there are great physiological variations within a single species. This would account for some of the apparent discrepancy in regard to the effects of these salts which have been tried so often. For a description of the behavior of a form of *Penicillium* peculiarly resistant to copper and one extraordinarily resistant to arsenic, see the work of De Seynes † and Gosio.‡

Stevens § tested the influence of a number of salts in inhibiting the germination of spores of several fungi. The following table compiled from one of his, gives the lowest inhibiting concentrations for the forms there named, with respect to those salts which he and I have both tested. I have corrected his terminology from *n* to *m*, and have added underneath his figures the approximately equivalent concentration in the normal and decimal system. The sign > preceding a concentration denotes that the limit as stated is somewhat too low.

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* Richter, A. Zur Frage der chemischen Reizmittel. Centralbl. für Bacteriol. **7**: 417–429. 1901.

† De Seynes, J. Resultats de la culture du *Penicillium cupricum* Trabut. Bull. Soc. Bot. France **42**: 451–455, 482–485. 1895.

‡ Gosio, B. Zur Frage wodurch die Giftigkeit arsenhaltiger Tapeten bedingt wird. Ber. Deutsch. Chem. Ges. **30**: 1024–1026. 1897.

§ Stevens, F. L. The effect of aqueous solutions upon the germination of fungus spores. Bot. Gaz. **26**: 377–406. 1898.

TABLE OF CERTAIN RESULTS OBTAINED BY STEVENS: LOWEST INHIBITING CONCENTRATION

Salt.	*Botrytis.*	*Macrosporium.*	*Gloeosporium.*	*Penicillium.*	*Uromyces.*
HCl	....	$> m/50$ $> 2n/100$	$> m/100$ $> n/100$	$> m/50$ $> 2n/100$	$m/50$ $2n/100$
H_2SO_4	....	$> m/50$ $> n/100$	$> m/100$ $> 5n/1,000$	$> m/50$ $> n/100$	$m/50$ $> n/100$
$CuSO_4$	$m/3,200$ $15n/10,000$	$m/6,400$ $75n/100,000$	....	$m/200$ $25n/10,000$	$m/3,200$ $15n/10,000$
$Cu(NO_3)_2$	$m/3,200$ $15n/10,000$	$> m/3,200$ $> 15n/10,000$	....	$m/200$ $25n/10,000$	$m/3,200$ $15n/10,000$
NH_4NO_3	$m/2$ $5n/10$	....	....	$m/2$ $5n/10$	$m/2$ $5n/10$
$MgSO_4$	....	....	....	$> m/10$ $> 5n/100$	....

Clark * worked in a field similar to that of Stevens, making valuable determinations of the effect of poisons upon fungus growth as well as upon the germination of spores. Below are presented those of his results which are of most interest in the present connection. The figures denote the lowest fatal strength for the organisms indicated. I have added the decimal equivalent as above, placing it to the right of the sign =, and have arranged the salts in the order of their toxicity.

TABLE OF CERTAIN RESULTS OBTAINED BY CLARK

Aspergillus.

Salt.	Fatal concentration.
$CoSO_4$	$n = n$
HCl	$n/4 = 25n/100$
$CuSO_4$	$n/4 = 25n/100$
$Cu(NO_3)_2$	$n/4 = 25n/100$
H_2SO_4	$n/8 = 125n/1,000$
HNO_3	$n/16 = 625n/10,000$
$Cd(NO_3)_2$	$n/64 = 156n/10,000$
$AgNO_3$	$n/2,048 = 49n/100,000$

Sterigmatocystis.

Salt.	Fatal concentration.
$CoSO_4$	$n = n$
$ZnSO_4$	$n = n$
HCl	$n/2 = 5n/10$
HNO_3	$n/4 = 25n/100$
$Ni(NO_3)_2$	$n/4 = 25n/100$
$Cu(NO_3)_2$	$n/4 = 25n/100$
$CuSO_4$	$n/8 = 125n/1,000$
H_2SO_4	$n/16 = 625n/10,000$
$Cd(NO_3)_2$	$n/32 = 313n/10,000$
$AgNO_3$	$3n/4,096 = 245/1,000,000$

Penicillium.

Salt.	Fatal concentration.
$CoSO_4$	$n = n$
$CuSO_4$	$n = n$
$Cu(NO_3)_2$	$n = n$
$ZnSO_4$	$n = n$
HCl	$n/2 = 5n/10$

Penicillium.

Salt.	Fatal concentration.
H_2SO_4	$n/2 = 5n/10$
$Ni(NO_3)_2$	$n/2 = 5n/10$
HNO_3	$n/4 = 25n/100$
$Cd(NO_3)_2$	$n/256 = 39n/10\ 000$
$AgNO_3$	$n/32,768 = 305n/10,000,000$

* Clark, J. F. On the toxic effect of deleterious agents on the germination and development of certain filamentous fungi. Bot. Gaz. **28**: 289–327, 378–404. 1899. — Electrolytic dissociation and toxic effect. Jour. Phys. Chem. **3**: 263–316. 1899.

Oedocephalum.		*Botrytis.*	
Salt.	Fatal concentration.	Salt.	Fatal concentration.
$CoSO_4$	$2n = 2n$	$ZnSO_4$	$n = n$
$ZnSO_4$	$n/2 = 5n/10$	$CoSO_4$	$n/4 = 25n/100$
HCl	$n/8 = 125n/1,000$	HCl	$n/8 = 125n/1,000$
HNO_3	$n/8 = 125n/1,000$	HNO_3	$n/16 = 625n/10,000$
H_2SO_4	$n/16 = 625n/10,000$	$CuSO_4$	$n/32 = 313n/10,000$
$Ni(NO_3)_2$	$n/16 = 625n/10,000$	$Cu(NO_3)_2$	$n/32 = 313n/10,000$
$CuSO_4$	$n/64 = 156n/10,000$	H_2SO_4	$n/64 = 156n/10,000$
$Cu(NO_3)_2$	$n/64 = 156n/10,000$	$Ni(NO_3)_2$	$n/128 = 78n/10,000$
$Cd(NO_3)_2$	$n/128 = 78n/10,000$	$Cd(NO_3)_2$	$n/4,096 = 245n/1,000,000$
$AgNO_3$	$n/32,768 = 305n/10,000,000$	$AgNO_3$	$n/8,192 = 123n/1,000,000$

The results of these studies of the relative toxicity of the metals toward algae and fungi are presented below in the form of lists, so that they may be more readily compared. The salts studied are arranged in order of their stimulating effect — beginning with the least effective — under the name of the subject. A vertical line at the left of several salts denotes their apparent equality in the series. Superscript letters attached to the subject names denote authors, as follows : (*a*) Richards ; (*b*) Ono ; (*c*) Livingston ; (*d*) Clark ; and (*e*) Stevens.

STIMULATION.

Aspergillus[a].	*Aspergillus*[b].	*Penicillium*[b].	*Protococcus*[b].	*Stigeoclonium*.[c]
$FeSO_4$	$HgCl_2$	$FeSO_4$	$ZnSO_4$	Ca
$NiSO_4$	$CuSO_4$	$CoSO_4$	$CoSO_4$	K
$CoSO_4$	$CoSO_4$	$HgCl_2$	$LiNO_3$	Sr
$ZnSO_4$	$NiSO_4$			Mg
	$ZnSO_4$			Na
	$LiNO_3$			Ba
				Rb
				NH_4
				Li
				Zn
				H
				Fe
				Ni
				Al
				Cd
				Co
				U
				Pb
				Cu
				Ag

FATAL STRENGTH

Aspergillus[d].	*Penicillium*[e].	*Penicillium*[d].	*Protococcus*[b].	*Botrytis*[e].	*Botrytis*[d].
$CoSO_4$	NH_4NO_3	$CoSO_4$	$HgCl_2$	NH_4NO_3	$ZnSO_4$
HCl	$MgSO_4$	$CuSO_4$	$ZnSO_4$	$CuSO_4$	$CoSO_4$
$CuSO_4$	HCl	$Cu(NO_3)_2$	$CoSO_4$	$Cu(NO_3)_2$	HCl
$CuNO_3$	H_2SO_4	$ZnSO_4$	$LiNO_3$		HNO_3
H_2SO_4	$CuSO_4$	HCl			$CuSO_4$
HNO_3	$Cu(NO_3)_2$	H_2SO_4			$CuNO_3$
$Cd(NO_3)_2$		$Ni(NO_3)_2$			H_2SO_4
$AgNO_3$		HNO_3			$Ni(NO_3)_2$
		$Cd(NO_3)_2$			$Cd(NO_3)_2$
		$AgNO_3$			$AgNO_3$

Macrosporium[e].	*Uromyces*[e].	*Sterigmatocystis*[d].	*Oedocephalum*[d].	*Stigeoclonium*[c].
HCl	NH_4NO_3	$CoSO_4$	$CoSO_4$	Ca
H_2SO_4	HCl	$ZnSO_4$	$ZnSO_4$	Mg
$Cu(NO_3)_2$	H_2SO_4	HCl	HCl	K
$CuSO_4$	$CuSO_4$	HNO_3	HNO_3	Na
	$Cu(NO_3)_2$	$Ni(NO_3)_2$	H_2SO_4	Sr
		$Cu(NO_3)_2$	$Ni(NO_3)_2$	Li
		$CuSO_4$	$CuSO_4$	NH_4
		H_2SO_4	$Cu(NO_3)_2$	Ba
		$Cd(NO_3)_2$	$Cd(NO_3)_2$	Rb
		$AgNO_3$	$AgNO_3$	Co
				H
				Zn
				Fe
				Ni
				U
				Al
				Cd
				Pb
				Cu
				Ag

A comparison of the above lists will make it clear at once that there is only a very general agreement between them. In the present state of our knowledge nothing more need be said.

The literature of the effect of toxic substances on higher plants, although more extensive, is in a more unsatisfactory state than that concerning the lower ones. It would be somewhat out of the field of the present paper to go here into detail as to the concentrations which accelerate growth and those which kill higher plants. It is well established that most of the metals, when at the right strength, do accelerate growth of seedling roots, but there is discrepancy among the several observers as to the limits. The same is true of fatal doses. Kahlenberg and True *

* Kahlenberg, L. & True, R. H. On the toxic action of dissolved salts and their electrolytic dissociation. Bot. Gaz. **22** : 81–124. 1896.

and Heald * worked upon *Lupinus*, *Pisum* and *Zea* radicles, finding an acceleration in case of the cations H, Cu, Ni, Co and Ag. Kahlenberg and Austin † determined the concentration of ionic H which can be borne by seedlings of *Lupinus* when their roots are in solutions of acid sodium salts. Coupin ‡ made determinations of the effect of solutions of salts of Na, K, and NH_4 upon wheat seedlings. Kanda § worked with *Pisum* and *Vicia* seedlings and with $CuSO_4$ and $ZnSO_4$. Studies on the toxicity of a number of acids and their Ca and K salts upon wheat, clover, and maize, were made by Cameron and Breazeale.‖ True and Gies ¶ have recently carried out what is probably now the most satisfactory research we have on this subject. They determined for *Lupinus* the stimulating strengths and fatal concentrations for the salts of Cu, Ag, Hg, Zn, Na, K, Ca and Mg. F. A. Loew** worked upon the effect of H and OH ions on *Zea* seedlings, and Dandeno†† has just published a paper on experiments in this line with seedlings of *Zea*, *Lupinus*, and *Pisum*. The latter author made determinations of the neutralizing power of seedling roots in toxic solutions, which appears to be a very important consideration and one which seems not to have been attacked before. This author demonstrates also, what had already been described by True and Oglevee ‡‡ that the presence of insoluble bodies has an influence upon the physiological effect of salt solutions. This is the phe-

* Heald, F. de F. On the toxic effect of dilute solutions of acids and salts upon plants. Bot. Gaz. **22**: 125–153. 1896.

† Kahlenberg, L. & Austin, R. W. The action of acid sodium salts on *Lupinus albus*. Jour. Phys. Chem. **4**: 553–569. 1900.

‡ Coupin, H. Sur la toxicité des composés du sodium, du potassium, et de l'ammonium à l'égard des végétaux supérieurs. Rev. Gén. Bot. **12**: 177–194. 1900.

§ Kanda, M. Studien über die Reizwirkung einiger Metallsalze auf das Wachsthum höherer Pflanzen. Jour. Coll. Sci. Imp. Univ. Tokyo 19[13]: 1–37. 1904.

‖ Cameron, F. K. & Breazeale, J. F. The toxic action of acids and salts on seedlings. Jour. Phys. Chem. **8**: 1–13. 1904.

¶ True, R. H. & Gies, W. J. On the physiological action of some of the heavy metals in mixed solutions. Bull. Torrey Club **30**: 390–402. 1903.

** Loew, F. A. The toxic effect of H and OH ions on seedlings of Indian corn. Science II. **18**: 304–308. 1903.

†† Dandeno, J. B. The relation of mass action and physical affinity to toxicity. Am. Jour. Sci. IV. **17**: 437–458. 1904.

‡‡ True, R. H. & Oglevee, C. S. The effect of the presence of insoluble substances on the toxic action of poisons. Science II. **19**: 421–424. 1904. — Also Bot. Gaz. **39**: 1–21. 1905.

nomenon of adsorption known to soil physicists for some time,* but only now applied to the study of toxicity of salts. It appears from Dandeno's paper that even the walls of the vessel in which a water culture is grown may exert an appreciable influence in this way, thus decreasing the stimulating power of a solution.

It is well to call attention here also to three papers in the same field in animal physiology. The influence of poison salts upon fishes was studied by Kahlenberg and Mehl † and determination made of the killing concentrations. As their results show, these authors were working largely with the toxic effect of the solutions upon the delicate vascular membranes of the gills. Kahlenberg ‡ also made a study of the relation of taste to acidity, in salts and acids. But by far the best and most satisfactory paper which has appeared from the animal side, and in many ways from the standpoint of all general physiology, is that of Mathews § who carefully determined for a large number of salts, the concentrations necessary to inhibit the development of eggs of the fish, *Fundulus heteroclitus*. His paper will be discussed to some degree a little farther on.

The effect of one salt or ion in counteracting that of another, when these are in a mixed solution is a very important topic in connection with the general subject of stimulation, Krönig and Paul,|| Clark,¶ Kearney and Cameron,** True,†† and True and Gies,§§ and others have investigated this question with interesting result which cannot be even touched upon here.

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* See Briggs, L. J. The mechanics of soil moisture. U. S. Dept. Agric. Div. of Soils, Bull. No. 10. 1897. — Investigations on the properties of soils. U. S. Dept. Agric. Field Operations Div. Soils, 1900: 415–421. 1901.

† Kahlenberg, L. & Mehl, H. F. Toxic action of electrolytes upon fishes. Jour. Phys. Chem. 5: 113–132. 1901.

‡ Kahlenberg, L. The relation of the taste of acid salts to their degree of dissociation. Jour. Phys. Chem. 4: 533–537. 1900.

§ Mathews, A. P. The relation between solution tension, atomic volume, and the physiological action of the elements. Am. Jour. Physiol. 10: 290–323. 1904. — See also his previous paper on nerve irritability, Science II. 17: 728–733. 1903.

|| Krönig, B. & Paul, T. Zeitschr. für Hygiene u. Infect. 25: 1–112. 1897.

¶ Clark, J. F. Jour. Phys. Chem. 5: 289–316. 1901.

** Kearney, T. H. and Cameron, F. K. U. S. Dept. Agric. Report No. 71. 1902.

†† True, R. H. Am. Jour. Sci. IV. 9: 183–192. 1900.

§§ True, R. H. & Gies, W. J. Bull. Torrey Club 30: 390–402. 1903.

Nature of toxicity

Although a number of attempts have been made to find out what it is in the nature of these toxic substances which gives them their stimulating power, there has been practically no outcome of it all until the appearance of Mathew's paper above referred to. Practically all of the toxicity series which have been made out seem to agree in certain respects, *e. g.*, they do not follow the valence of the elements involved, nor do they follow the order of atomic weights; on the other hand, it is usually evident that, in some sort of a general way, they do depend upon the chemical nature of these elements, the more inert atoms always appearing as of low stimulating power while Cu, Ag, Pt, etc., lie at the opposite end of the series. This much is as evident from my work as it is from that of Kahlenberg and True, Clark and Mathews.

The last-named author has discovered a remarkable similarity between his toxicity series and three chemical series formed on the basis, respectively, of *solution tension*, *atomic volume*, and a *function obtained by dividing the equivalent weight by the atomic volume*. With none of these series my results agree accurately, but a comparison of his published tables with those here presented (page 20) will show some remarkable points of resemblance. It would appear from a comparison of all the work available on this subject that, while the suggestion of the author just named seems to fall short of explaining the relation of toxicity in general to chemical properties, yet he has at least given us the only rational basis for exploration of this difficult field.

That different organisms behave differently in the same solution is to be expected from the mere fact that they *are* different organisms, *i. e.*, that their protoplasms are not identical. The points of similarity in different protoplasms have become so strongly emphasized (as is illustrated by the fact that we use the single term protoplasm to include them all), that their essential points of difference have often been partially lost sight of. The toxicity series for any form is doubtless conditioned by a complex function derived, on the one hand, from the properties of its protoplasm as an organic mixture and a colloidal solution, and, on the other, from some such properties of the elements as those considered by Mathews.

It would be unnecessarily increasing the bulk of literature to attempt a discussion of the discrepancies between the different series at hand. It is almost certain that the present lively activity of physiologists in this regard will soon unearth additions to our knowledge of the facts which will be vastly more valuable than any amount of the older-fashioned *a priori* discussion of all the conceivable possibilities of the case. The writer hopes in the near future to study in a similar manner the influence of anions and of certain organic poisons upon this organism.

SUMMARY

The important results here described may be briefly stated as follows:

1. Nitrate and sulfate, in the case of a large number of metallic elements, act in the same way and at the same concentration upon the filamentous form of this alga. According to the theory of dissociation, we conclude that the stimulation is due to the cations.

2. At high enough concentrations death is produced.

3. At somewhat lower concentrations most of the cations produce a change in form of the cells and in the manner of cell division, which is strictly parallel to the change brought about by extraction of water or inhibition of its absorption.

4. Often at the same concentration as that mentioned in (3), and in most cases at a strength somewhat lower than this, there is a marked acceleration in the production of zoöspores. This is exactly the opposite of what results from water-extraction.

5. The acceleration in zoöspore activity gradually decreases with weaker solutions of the poison until the normal behavior of the filamentous form is reached.

6. In general, the relative degrees of toxicity of the metals here studied follow the order of those studied by other workers with different organisms. But there are many unexplained discrepancies.

THE DESERT BOTANICAL LABORATORY OF THE
CARNEGIE INSTITUTION, TUCSON, ARIZONA, Aug. 5, 1904.

Amphispores of the grass and sedge rusts *

Joseph Charles Arthur

There is but one known exception (*Puccinia graminella*) to the general statement that all plant-rusts occurring on grasses and sedges possess in their life-cycle the full complement of spores characteristic of the *Uredineae*, *i. e.*, aecidiospores, uredospores and teleutospores. In the majority of cases knowledge of the cycle is yet incomplete, and the aecidiospores and sometimes the uredospores are yet to be detected and described, but there is no reason to doubt that they exist. All grass and sedge rusts belong to either the genus *Puccinia* or *Uromyces*.

Species of *Puccinia* often possess one-celled teleutospores, which are called mesospores. Such spores do not differ structurally or physiologically from the normal two-celled teleutospore of the species, except that the lower cell is wanting.

A few species, belonging to both *Puccinia* and *Uromyces*, possess two sorts of uredospores, which differ both structurally and physiologically, and in the most marked forms the divergence is very wide. A good, and in some ways the best illustration of the two forms of teleutospores and uredospores may be found in *Puccinia vexans*, a species of which Sydow † remarks in his monograph of the *Uredineae*, that here is presented the interesting fact of a *Puccinia* with two different teleutospores and two sorts of uredospores.

Uredospores in general serve the purpose of summer spores for the rapid dissemination of the species. Their walls do not protect the spore from much drying or great extremes of temperature. As soon as mature they drop away readily, and are free to be blown about by the wind.

The modified uredospores, to which the name amphispore was

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* Read before the Indiana Academy of Sciences, at Indianapolis, Nov. 25, 1904.

† "So hätten wir die interessante Tatsache, dass eine *Puccinia* zwei verschiedene Teleutosporen und zweierlei *Uredosporen* hervorbringt." Sydow, Monog. Ured. 1 : 736. 1904.

given by Carleton * in 1901, are on the contrary resting spores, and possess thick, indurated walls, colorless contents and persistent or semi-persistent pedicels. The sori appear to the naked eye, and under a hand lens, like those of the teleutospores, for which they are often mistaken. This mistake has, in a number of instances, led to their description as species of *Uromyces;* thus *U. Brandegei* Pk., *U. simulans* Pk., *U. scaber* E. & E., *U. Caricis* Pk., and *U. atrofusca* Dudl. & Th., are names of the amphisporic stages of different species of *Puccinia.* Amphispores can always be told from true teleutospores, however, by possessing two or more germ pores, while teleutospores have but one, and that is usually not discernible except at time of germination.

Amphispores appear to belong to species having their main development in arid or semi-arid regions. They give to the uredospore the same power to tide over unfavorable periods of growth that is usually possessed only by the teleutospore, and with the additional advantage that when the inhibiting period is past they can infect the same host from which they were derived, whereas the teleutospore can only infect an alternate host of a different species.

Up to the present time no species found to possess amphispores is known outside the United States and Mexico, with the single exception of an Indian species occurring in the Himalayas. Most of the collections have been made in the semi-arid regions of North America. Because this form of spore is not usually recognized, and not well understood, the writer presents the following notes and illustrations, drawn from specimens in his herbarium.

1. PUCCINIA VEXANS Farl. (*Uromyces Brandegei* Pk.) has globoid uredospores with golden yellow, thin walls, minutely echinulate, and showing eight scattered germ pores. Their pale color makes them comparatively inconspicuous, moreover they are but sparingly produced, and in consequence but rarely collected.

The amphispores are much larger than the uredospores, obovate, semiopaque, and with dark chestnut-brown walls, very thick, much thicker above, densely verrucose, and possessing four germ pores which are symmetrically arranged in a circle just below the

* Science II. 13: 249.

equator. The pedicels are long and persistent, and resemble those of the teleutospores. The sori look like the teleutosori. They sometimes have an intermixture of either uredospores or teleutospores, but more often are without either. They are the most abundant spore-form of the species. It is not yet known what are the favorable conditions for germination, and Carleton * is yet alone in a successful attempt to start them into growth. In a study of the evolution of this form the fact, that occasionally the usually smooth teleutospores show on their apical portion a ver-

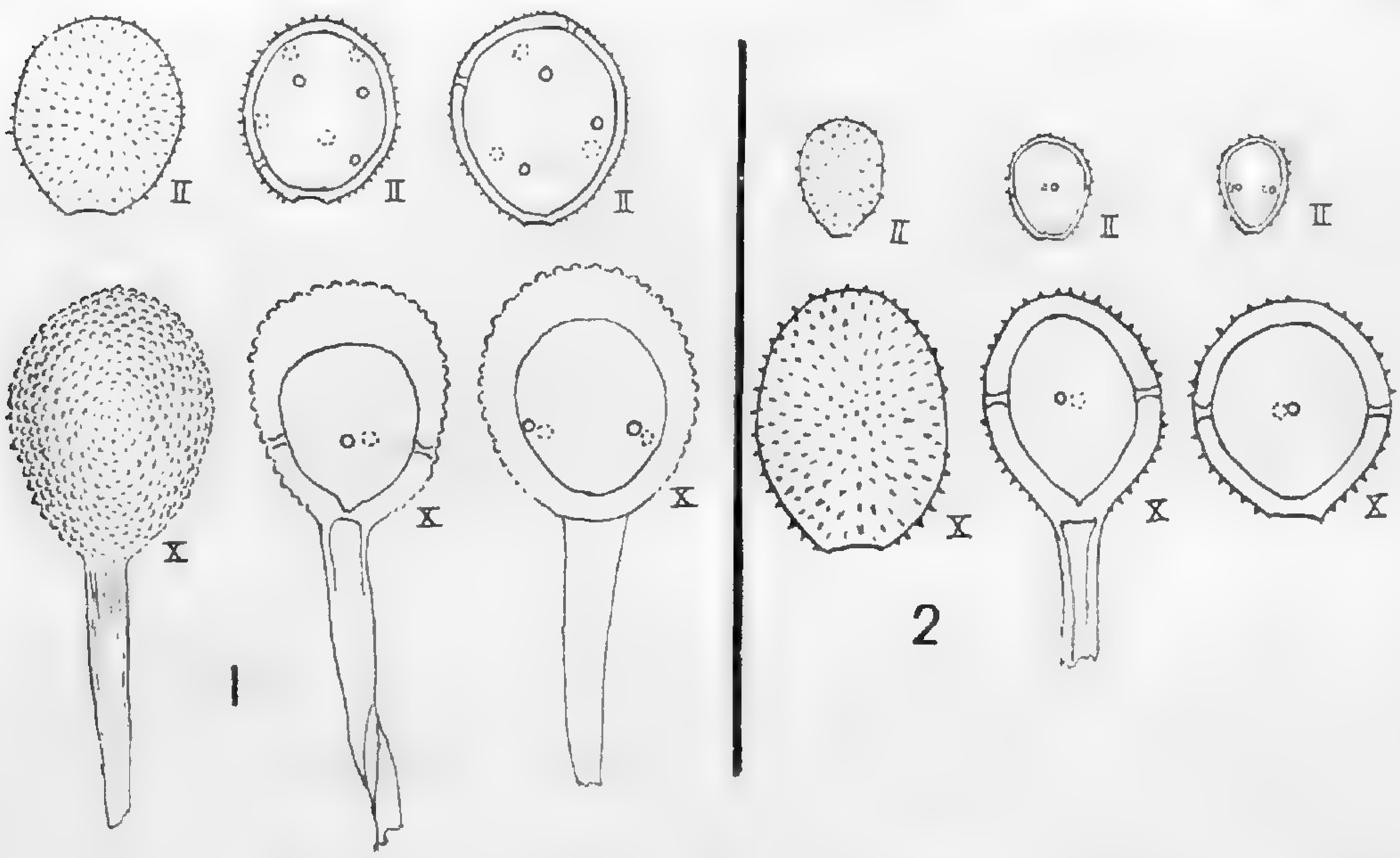


FIGURE 1. *Puccinia vexans* Farl.; on *Atheropogon curtipendulus.* Central United States and Mexico. II, Uresdopores. X, Amphispores.

FIGURE 2. *Puccinia Tripsaci* D. & H.; on *Tripsacum dactyloides.* Southern United States and Mexico. II, Uredospore. X, Amphispores.

rucose sculpturing similar to that of the amphispores, will doubtless prove significant. The species ranges from Iowa and Nebraska to central Mexico.

2. PUCCINIA TRIPSACI D. & H. (*Uredo pallida* D. & H.) has remarkably small, very pale uredospores, with very thin, minutely verrucose-echinulate wall, having four equatorial pores. The sori appear white.

The amphispores resemble the uredospores in shape, echinulation and germ pores, but are immensely larger in every way. The wall is cinnamon-brown, and the sori are conspicuous. They occur in connection with the uredosori, teleutosori, or alone.

* Investigations of rusts. Bull. Bureau Pl. Ind. 63 : 23. 1904.

There is such a great difference between the two uredo forms that some mycologists are not willing to accept the relationship here claimed. Absolute proof can not be offered until cultures have been made. The species extends through central Mexico and northward into the United States.

3. PUCCINIA STIPAE Arth. (*Uredo Eriocomae* Ellis, *U. luxurians* E. & E., *Puccinia substerilis* E. & E., *P. micrantha* Griff.) has uredospores of the usual appearance, globoid, with rather thin, pale yellow walls, echinulate, with about six scattered germ pores. The sori are yellow and inconspicuous.

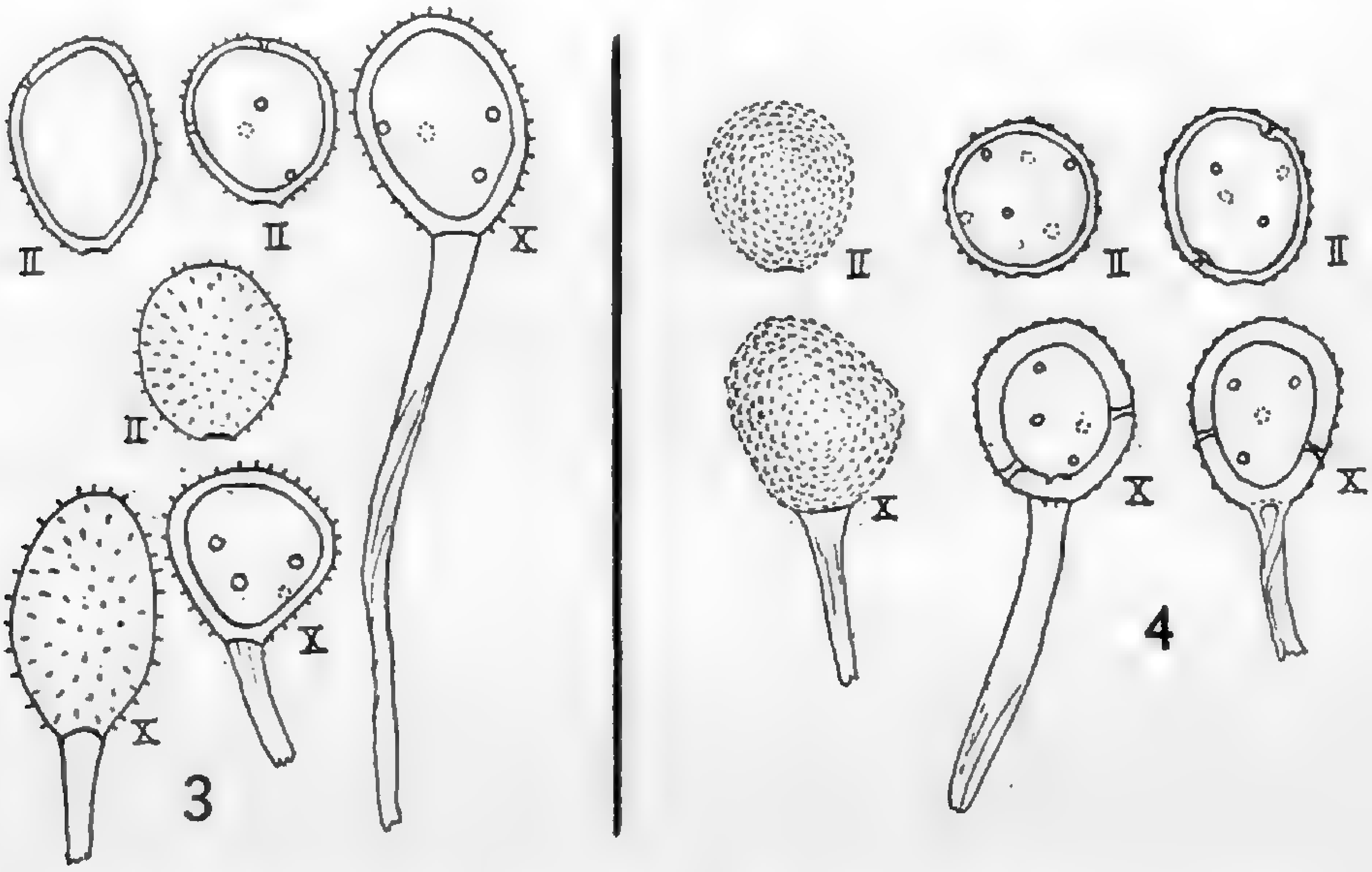


FIGURE 3. *Puccinia Stipae* Arth.; on *Stipa*, *Oryzopsis* and *Eriocoma*. Central United States and Mexico. II, Uredospores. X, Amphispores.

FIGURE 4. *Puccinia tosta* Arth.; on *Sporobolus airoides*, etc. Central United States. II, Uredospores. X, Amphispores.

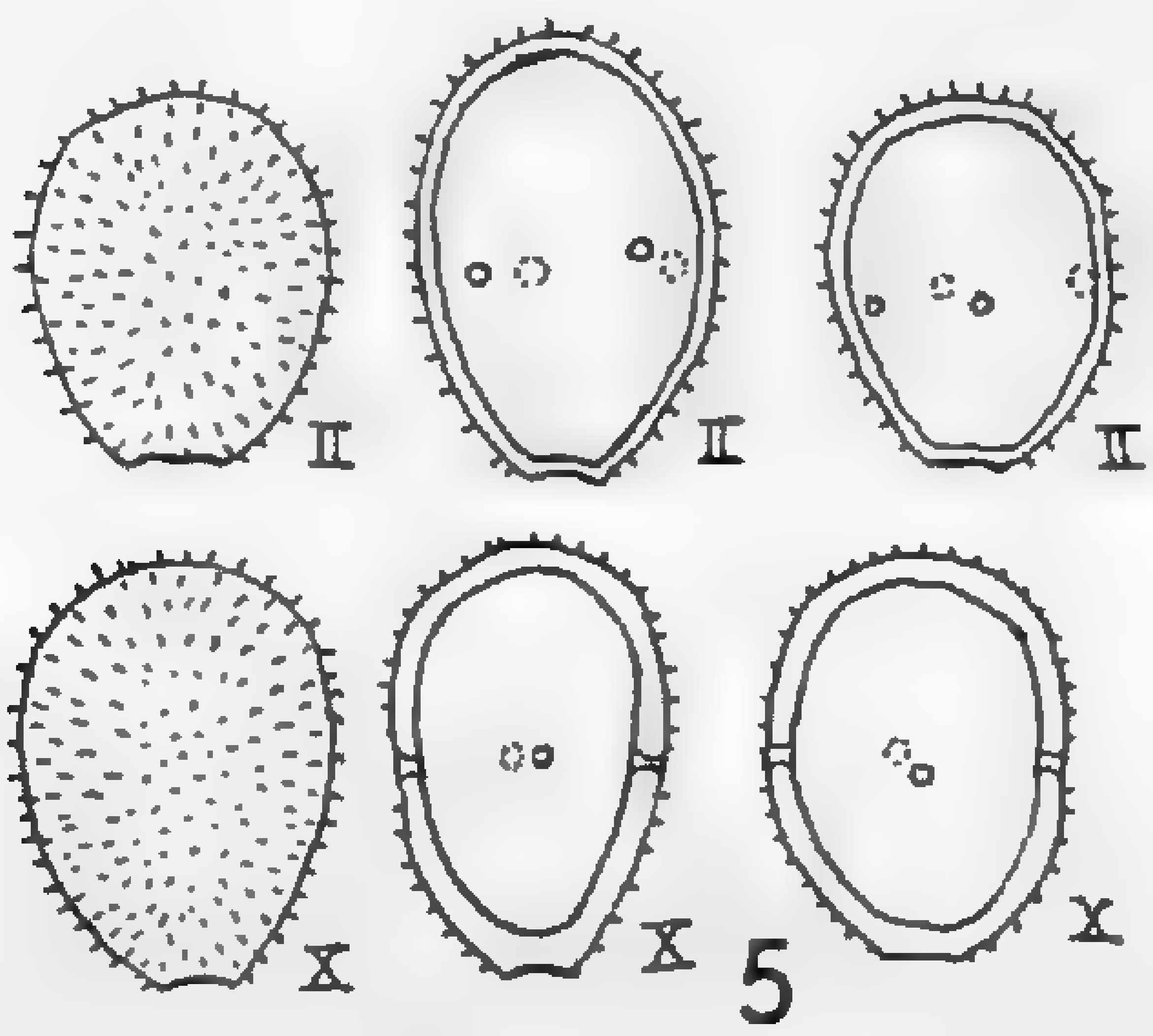
The amphispores have heretofore been considered the uredoform of a separate species, and have been called *Uredo luxurians* and *Puccinia substerilis*. They are about the same size as the uredospores, more inclined to be ellipsoid, with a much thicker, cinnamon-brown wall, strongly echinulate, and with pores similarly arranged. The pedicels are persistent, and often very long. The sori are dark brown, conspicuous, and have the appearance of teleutosori. Amphispores have been found on *Stipa viridula*, *S. Vaseyi* and *Eriocoma cuspidata*. The species ranges from Manitoba to New Mexico and Arizona.

4. PUCCINIA TOSTA Arth. (*Uromyces scaber* E. & E.) has

globose uredospores, with rather thin brownish yellow wall, finely verrucose, and with about six scattered germ pores.

The amphispores are similar, but with very much thicker walls, deeper colored, somewhat more coarsely verrucose, and with persistent pedicels. They are very rarely collected, and are only known to the writer from Colorado, on what is probably *Sporobolus airoides*. The type of *Uromyces scaber* was given as "an unknown grass," and has not been seen by the writer, but is clearly the amphisporic stage of this species. The species ranges from Montana and South Dakota to Texas and Arizona.

5. PUCCINIA CRYPTANDRI Ell. & Barth. (*Uromyces simulans* Pk.) rarely presents any other form of uredo than the amphispore. If the usual thin-walled uredospore does occur as a clearly marked form, it has been rarely collected. There is no collection of the



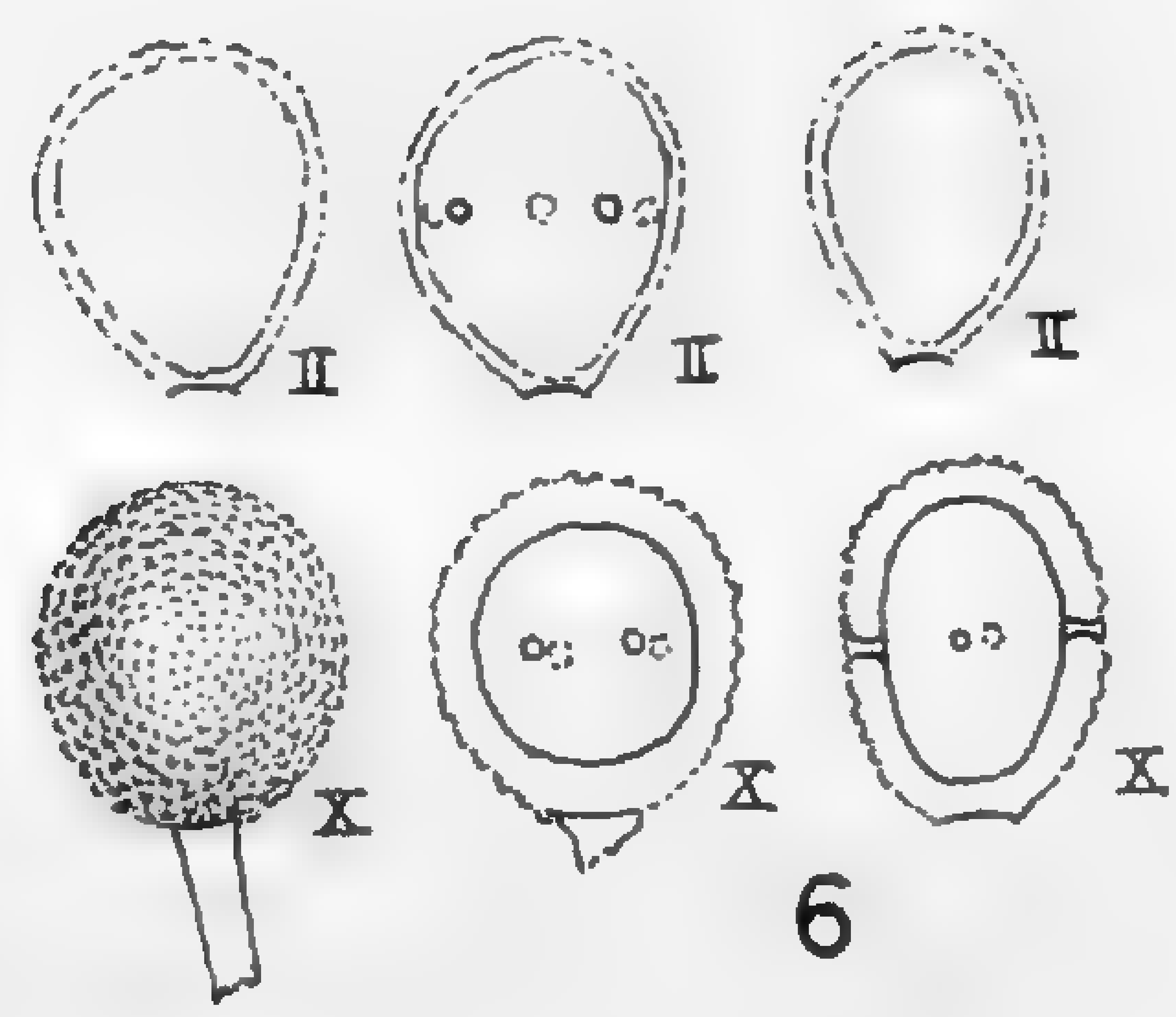


FIGURE 5. *Puccinia Cryptandri* E. & B.; on *Sporobolus cryptandrus*, etc. Central United States. II, Uredospores. X, Amphispores.

FIGURE 6. *Uromyces Rottboelliae* Arth.; on *Rottboellia speciosa*. Northern India, alt. 2100 m. II, Uredospores. X, Amphispores.

species in the writer's herbarium gathered earlier in the season than the middle of August. Spores from a collection made August 21 are figured as the summer form of the spore. The walls are thin, and the spore appears paler and less firm than in collections made in October and November. The usual autumn collections have the characteristics of amphispores. The sori are dark cinnamon-brown, with apparently persistent spores, although in transferring them to the microscope they separate readily from the pedicels. The type of *Uromyces simulans* has been examined, and the amphisporic character of the spores is especially marked. Some experimental evidence that these are resting spores, and consequently amphispores, is afforded by the successful germination by Carleton * of spores that had lain in the herbarium a year. The distinction between summer uredospores and the resting form or amphispores in this species needs further study. The species ranges from Montana to Arizona, and as far east as Tennessee.

6. UROMYCES ROTTBOELLIAE Arth. was described from very limited material, and while characteristic teleutospores and amphispores were present, no specially good examples of true uredospores were seen. So far as could be judged the uredospores are thin-walled, and pale, but otherwise like the amphispores.

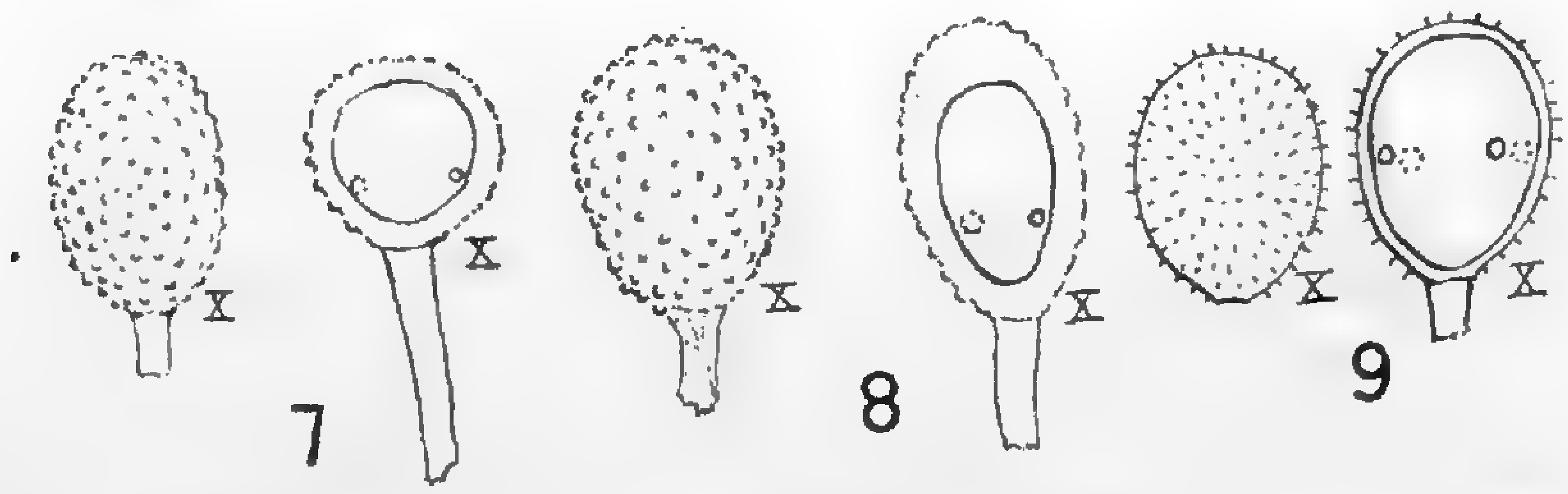


FIGURE 7. *Puccinia Caricis-strictae* Diet.; on *Carex stricta*. New York. X, Amphispores.

FIGURE 8. *Puccinia atrofusca* (D. & T.) Holw.; on *Carex Douglasii* and *C. usta*. Western coast of United States. X, Amphispores.

FIGURE 9. *Puccinia Garrettii* Arth.; on *Carex Hoodii*. Utah. X, Amphispores.

The amphisori are prominent and have the gross appearance of dark brown teleutosori. The spores are globoid, very thick-walled, finely verrucose, with four equatorial pores.

7. PUCCINIA CARICIS-STRICTAE Diet. (*Uromyces Caricis* Pk.) has been collected but once. It was found near Albany, N. Y., in October, 1876, and distributed in Thuemen's *Mycotheca universalis, no. 746*, and has not been met with since. To the naked eye the sori look like teleutosori. The spores have uniformly thick, dark brown walls, finely verrucose, with two pores, opposite and a little below the equator, and have colorless semipersistent pedicels. It seems impossible to find even stray uredospores of the summer form on the material of this collection. A few teleutospores occur, and on the evidence of these Dietel placed the species in the genus *Puccinia*.

8. PUCCINIA ATROFUSCA (D. & T.) Holw. (*Uromyces atrofuscus* Dudl. & Thomps.) is a western species recently found in Wash-

* Bull. Bureau Pl. Ind. 63: 21.

ington and California, on *Carex Douglasii* and *C. usta*. It closely resembles the preceding species, and like it shows no summer form of the uredospores, and only a few intermixed teleutospores. The amphispores are similar to the last in color, surface markings and pores, but they are a little larger and have the upper part of the wall decidedly thicker than the sides.

9. **Puccinia** (?) **Garrettii** n. sp. Two collections of this new form, obtained at Salt Lake City, Utah, on *Carex Hoodii* Boott, have recently been sent to me by A. O. Garrett: *no. 333*, Sept. 10, 1904, and *no. 614*, Oct. 11, 1904, the latter being taken as the type. The sori resemble teleutosori, but contain only amphispores. Not a single teleutospore could be found, and the species is referred to the genus *Puccinia* on the ground that most *Carex* rusts belong to it. Summer form of uredospores could not be found. The amphisori are amphigenous, scattered, oblong, chestnut-brown, slightly pulverulent; amphispores obovate or globoid, 21–26 by 27–35 μ, wall dark brown, rather thin, 1–1.5 μ, evenly echinulate, pores variable, 3–4, equatorial, pedicel colorless, semipersistent, one half to once length of spore. The species is notable in possessing the thinnest-walled amphispores yet known.

From the above descriptions and illustrations, which embrace all examples so far known, it will readily be seen that amphispores are the resting or winter form of uredospores. They are, however, no longer uredospores, accurately speaking, because they show distinct structural differences, often very great, and are correspondingly modified physiologically. They are clearly entitled to recognition as a distinct sort of spore.

Purdue University.

Additions to the fossil flora from Cliffwood, New Jersey

Edward Wilber Berry

(With plates 1 and 2)

The following notes are based for the most part on rather indefinite remains of vegetable origin, most of which have washed out of the Cretaceous clays at Cliffwood, N. J., by the action of the waves. Fossil-bearing layers in the clays which go to form the cliff at this locality have been so obscured by landslips, caused by the sea eating into the bluff, that good collections are not to be had at the present time.

Previous contributions by Dr. Arthur Hollick * and the writer † have given a fair idea of the flora of this horizon, and render the present condition of the exposure less regrettable than would otherwise be the case.

Microzamia (?) **dubia** sp. nov. Plate 1, figure 2

This appears to be the central axis of a small cycadeous fruit-spike or similar body of unknown affinity, from which the fruit bodies have been shed or macerated, leaving a regular ascending series of rounded pits about 1.5 mm. in depth, with thin sides tending to a hexagonal outline at the surface; across the bottom of nearly all of the pits is a thin transverse wall projecting into the cavity, in some cases nearly to the surface.

Our specimen is much smaller than the remains of *Microzamia gibba* (Reuss) Corda which are of common occurrence in the Raritan at Woodbridge, N. J., and does not compare closely with Newberry's figures,‡ which are not particularly good, however. The Cliffwood specimen is silicified and not in the least compressed, whereas the remains in the Woodbridge clays are all flattened and carbonaceous. The resemblance to the central axis of Corda's

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* Hollick, Trans. N. Y. Acad. Sci. **16**: 124–136. *pl. 11–14.* 1897.

† Berry, Bull. N. Y. Bot. Gard. **3**: 45–103. *pl. 43–57.* 1903.—Am. Nat. **37**: 677–684. *f. 8.* 1903.—Bull. Torrey Club **31**: 67–82. *pl. 1–5.* 1904.—Amer. Geol. **34**: 253–260. *pl. 15.* 1904.

‡ Newb. Fl. Amboy Clays, *pl. 12. f. 6, 7.* 1896.

f. 1 * is sufficiently striking to render it reasonably sure that we have here homologous remains. Two specimens, the larger of which was subsequently lost, were obtained from the beach at Cliffwood.

Brachyphyllum macrocarpum Newb. Plate 2, figure 9

Thuites crassus Lesq. Cret. & Tert. Fl. 32. 1884.

Brachyphyllum crassum Lesq. Proc. U. S. Nat. Mus. **10**: 34. 1887 (not *B. crassum* Tenison-Woods, Proc. Linn. Soc. N. S. Wales **7**: 660. 1883); Fl. Dak. Group, 32. *pl. 2. f. 5.* 1892. — Newb. Fl. Amboy Clays, 51. *pl. 7. f. 1–7.* 1896.

Brachyphyllum sp., Knowlton, Bull. Geol. Soc. Am. **8**: 137, 140. 1897.

Brachyphyllum macrocarpum Newb. Fl. Amboy Clays, 51 (footnote). 1896. — Knowlton, Bull. U. S. Geol. Surv. **152**: 51. 1898; **163**: 29. *pl. 4. f. 5, 6.* 1900. — Hollick, Bull. N. Y. Bot. Gard. **3**: 406 *pl. 70. f. 4, 5.* 1904.

This common Dakota and Raritan species is represented by the silicified portion of a branch 5 cm. long and 1.5 cm. in diameter. The leaves are broken away on one side, showing that they were 4 mm. in thickness.

This species must be far less common in the Matawan formation than it is in the Raritan, as it has not before been met with in three years collecting at this locality.

Brachyphyllum is a characteristic genus of the Triassic, Jurassic and Neocomian, the present species, which extends upward into the Montana formation, being the only American species which existed after the Lower Cretaceous.

Sequoia gracillima (Lesq.) Newb.

Cones of this species continue to be the most common fossils from this horizon. They are of all sizes and degrees of preservation and are very characteristic objects.

In view of the intimate relation between these Cliffwood clays and the Raritan clays to the westward, it is remarkable that the latter have not yielded a single specimen of this cone, which is so excessively abundant at Cliffwood. This is satisfactory evidence of the distinctness of the two formations.

Previously recorded specimens have exceeded 10 cm. in length and one large one collected this summer is 2.5 cm. in diameter.

Sequoia Reichenbachi (Gein.) Heer. Plate 1, figure 3

The specimen figured represents a staminate cone of this

* Corda in Reuss, Verst. d. böhm. Kreidef. *pl. 46. f. 1–10.* 1845.

Sequoia. It is almost twice as large as the similar remains of this species from Spitzbergen figured by Heer * and the scales are narrower. The same author, however, figures (*loc. cit. f. 4*) a larger detached cone which is even larger than our specimen.

The Cliffwood remains are also considerably more robust than are the staminate cones of either of the two living species of *Sequoia.*

Undetermined cone. PLATE I, FIGURE I

This cone terminates a large branch 7 mm. in diameter. It is much incrusted and obscured with pyrites and shows large thick pointed scales. There is some resemblance to the large cone (*f. 4*) which Heer (*loc. cit.*) referred to *Sequoia Reichenbachi* (Gein.) Heer, and also to cones which have been referred to *Cunninghamites*,† although the scales in our specimen are apparently thicker, but this may be due to incrustation. The twig to which it is attached, by reason of the leaf-scars, is certainly comparable with *Sequoia* or *Cunninghamites.* Unusual interest attaches to this specimen as it is from a much higher horizon than that at Cliffwood, it being from near the top of what the New Jersey Geological Survey designates as Clay Marl No. 2 between the towns of Matawan and Hazlet, N. J.

PINUS ANDRAEI Coem. (?). PLATE I, FIGURES 4, 5 AND 6

Coemans, Mém. Acad. Roy. Belg. **36**: 12. *pl. 4. f. 4; pl. 5. f. 1.* 1867.

The plate shows remains of another species of doubtfully determined cones, this locality being remarkable for the abundance of coniferous remains of all kinds which it has furnished.

These cones seem somewhat lax, and all are considerably distorted. They may be referable to *Cunninghamites*, the larger (*f. 6*) showing considerable resemblance to the cone from Niederschoena, Saxony, which Ettingshausen referred to *Cunninghamites Oxycedrus* Sternb., but it is not certain that this species is correctly identified by Ettingshausen.

Our larger specimen in its general appearance and character of its scales is very close to if not identical with Coemans' species, and I am inclined to the opinion that these somewhat lax cones during the time that they were being covered received much sedi-

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* Heer, Fl. Foss. Arct. **32**: 127. *pl. 36 f. 3, 3b.* 1874.

† Compare for instance with Ettings. Sitz. Akad. Wiss. **55**: *pl. 1. f. 4.* 1867.

ment beneath the scales, the subsequent pressure distorting them and causing the scales to stand out at almost right angles to the axis, for it may be noted that they are all nearly flat on one side.

I have provisionally referred them to Coemans' species, from the nearly homotaxial horizon in Belgium, to which they are at least very closely related.

Myrica Brittoniana nom. nov.

Myrica Heerii Berry, Am. Nat. **37**: 682. *f.* 7, 8. 1903. Not *M. Heerii* Boulay.

I find that this beautiful species of *Myrica* cannot retain the name commemorative of the eminent Swiss paleobotanist, which was previously used by Boulay, Bull. Soc. Bot. France, **34**: 255 (1887) for a Miocene species. I take pleasure in renaming it in honor of the distinguished Director of the New York Botanical Garden.

BETULITES POPULIFOLIUS Lesq.(?) PLATE 2, FIGURE 6

Betulites populifolius Lesq. Fl. Dak. Group, 64. *pl.* 6. *f.* 1, 2. 1892.

This species, heretofore known only from the Dakota Group of Kansas, is represented by a fragment which does not show the outline of the leaf, but agrees in venation with Lesquereux's species. This identification is not above question, however.

MAGNOLIA SPECIOSA Heer. PLATE 2, FIGURES 4 AND 5

The collections contain numerous fragments of a rather large leaved *Magnolia* which I refer to this species.

LAURUS PROTEAEFOLIA Lesq. PLATE 2, FIGURE 3

Recent collections contain several leaves of this species, including the one here figured.

CELASTROPHYLLUM ELEGANS Berry. PLATE 2, FIGURE 1

Celastrophyllum elegans Berry, Bull. N. Y. Bot. Gard. **3**: 84. *pl.* 43. *f.* 6. 1903

My collections contain a hitherto unnoticed fragment of a much larger leaf of this species.

DIOSPYROS PRIMAEVA Heer. PLATE 2, FIGURE 2

Diospyros primaeva Heer, Phyll. Crét. Nebr. 19. *pl.* 1. *f.* 6, 7. 1866; Fl. Foss. Arct. **6**^{2}: 80. *pl.* 18. *f.* 11. 1882; **7**: 31. *pl.* 61. *f.* 5a, b, c. 1883. = Lesq. Fl. Dak. Group, 109. *pl.* 20. *f.* 1–3. 1892. — Smith, Geol. Coastal Plain Ala. 348. 1894. — Newb. Fl. Amboy Clays, 124. *pl.* 30. *f.* 1–5. 1896. — Knowlton, Ann. Rep. U. S. Geol. Surv. **21**^{7}: 317. *pl.* 39. *f.* 3. 1901.

This species has been found in the Tuscaloosa of Alabama and the Raritan of New Jersey, in the Dakota Group of Kansas, Nebraska, and Texas, and in the Atane and Patoot beds of Greenland, thus ranging from the Albian to the Senonian.

These leaves are common in the upper Raritan at South Amboy, N. J.; the Cliffwood leaf is however somewhat smaller and lacks the prominent tertiary areolation of the Raritan leaves.

Eucalyptus Wardiana nom. nov.

Eucalyptus dubia Berry, Bull. N. Y. Bot. Gard. **3**: 87. *pl. 52. f. 1.* 1903. Not *E. dubia* Ettings.

I find the name originally given to this species was used by Ettingshausen in 1887 * for a rather similar leaf from the Eocene of Shag Point, New Zealand, and I therefore take pleasure in naming the Cliffwood leaf in honor of Professor Lester F. Ward, whose valuable system of records enabled me to discover my mistake.

Phyllites cliffwoodensis sp. nov. PLATE 2, FIGURE 8

A leaf probably 8–10 cm. long and 2.5 cm. wide with rounded base and slightly undulate margin. Midrib mediumly stout, particularly toward the base; secondaries nearly straight, ascending.

CARPITES MINUTULUS Lesq.

Carpites minutulus Lesq. Tert. Fl. 305. *pl. 60. f. 25.* 1878.

A small, smooth, thin seed with rounded base and gradually pointed apex, 3 mm. long and 1.5 mm. wide across the widest portion. It is exactly similar in size and form to this species of Lesquereux's from the Denver Group at Golden, Colorado, for which reason I have not figured the Cliffwood remains.

Lesquereux's specimens were mixed with the crushed and unidentifiable branches of some conifer. It is possible that these seeds are referable to some species of *Sequoia*, the seeds of a number of species of which are very similar except for the winged margin, which is very small and might readily disappear during fossilization.

Carpolithus ostryaeformis nom. nov.

Carpolithus virginiensis Berry, Bull. N. Y. Bot. Gard. **3**: 100. *pl. 48. f. 5.* 1903. Not *C. virginiensis* Font.

In the Bulletin of the New York Garden (*loc. cit.*) I provision-

* Beitr. z. Kennt. foss. Fl. Neuseelands, 32. *pl. 6. f. 5, 5a.*

ally referred a well preserved nutlet to *Carpolithus virginiensis* Font. although I was very doubtful at the time of there being any relationship with Fontaine's species, which only occurs at a much lower horizon. I am now convinced that the Cliffwood specimen is entirely distinct, and much search shows that it greatly resembles the nuts of our common *Ostrya virginiana* (Mill.) Willd. So close is this resemblance that I have decided to name the species as above.

Leaves of the genus *Ostrya* have not been found in strata earlier than the Tertiary, where three species have been found in this country and six or seven in Europe, ranging from the Eocene upward. The interrupted distribution of the living species, *e. g.*, two in the eastern United States, one in Europe and Asia, and another in Japan, taken in connection with the distribution of the fossil species stamps the genus as an old one, very likely to occur in the Cretaceous.

Carpolithus mattewanensis sp. nov. PLATE 2, FIGURE 7

An elliptical, smooth, and hard seed or nutlet, slightly flattened. Length about 4 mm., width 3 mm. Botanical relations entirely unknown.

Explanation of plates 1 and 2

PLATE 1

FIGURE 1. Undetermined cone.
FIGURE 2. *Microzamia* (?) *dubia* sp. nov.
FIGURE 3. *Sequoia Reichenbachi* (Gein.) Heer, staminate cone.
FIGURES 4, 5, 6. *Pinus Andraei* Coem. (?)

PLATE 2

FIGURE 1. *Celastrophyllum elegans* Berry.
FIGURE 2. *Diospyros primaeva* Heer.
FIGURE 3. *Laurus proteaefolia* Lesq.
FIGURES 4, 5. *Magnolia speciosa* Heer.
FIGURE 6. *Betulites populifolius* Lesq. (?)
FIGURE 7. *Carpolithus mattewanensis* sp. nov.
FIGURE 8. *Phyllites cliffwoodensis* sp. nov.
FIGURE 9. *Brachyphyllum macrocarpum* Newb.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Allen, C. E. Some *Hepaticae* of the Apostle Islands [Lake Superior]. Trans. Wis. Acad. **14**: 485, 486. 1904.

Bailey, W. W. The eve of departure. Am. Bot. **7**: 41–43. [N] 1904.

Bailey, W. W. River botanizing. Plant World **7**: 276, 277. [D] 1904.

Bailey, W. W. Witch hazel. Am. Bot. **7**: 48–50. [N] 1904.

Bergen, J. Y. Relative transpiration of old and new leaves of the *Myrtus* type. Bot. Gaz. **36**: 446–451. 20 D 1904.

Berry, E. W. The Cretaceous exposure near Cliffwood, N. J. Am. Geol. **34**: 253–260. *pl. 15*. O 1904.

Enumerates all the fossil plants known from this locality, with their geological distribution.

Berry, E. W. Recent contributions to our knowledge of Paleozoic seed-plants. Torreya **4**: 185–188. 30 D 1904.

Blakeslee, A. F. Sexual reproduction in the *Mucorineae*. Proc. Am. Acad. Arts & Sci. **40**: 203–320. *pl. 1–4*. Au 1904.

Boeweg, H. The histology and development of *Cassytha filiformis* L. Trans. & Proc. Bot. Soc. Pa. **1**: 399–416. *pl. 33, 34*. 1904.

Boyer, C. S. *Cryptogamia.* Md. Geol. Surv. Miocene, 487–507. *pl. 134, 135.* 1904.
Diatomaceae only.

Brainerd, E. *Scirpus validus* and allies in the Champlain valley. Rhodora **6**: 231, 232. 16 D 1904.

Britton, E. G. Notes on nomenclature, IV. — The genus *Neckera.* Bryologist **8**: 4–6. 27 D 1904.

Britton, N. L. Report on exploration of the Bahamas. Jour. N. Y. Bot. Gard. **5**: 201–209. *f. 36–39.* N 1904.

Buscalioni, L. Sulla caulifloria. Malpighia **18**: 117–177. *pl. 2, 3.* 1904.
A discussion of cauligerous inflorescence, including many American species.

Chamberlain, E. B. New stations for Maine plants — II. Rhodora **6**: 232, 233. 16 D 1904.

Christensen, C. A new *Elaphoglossum* from Brazil. Bot. Tidsskr. **26**: 299, 300. 30 N 1904.
E. didymoglossoides sp. nov.

Christensen, C. On the American species of *Leptochilus* sect. *Bolbitis.* Bot. Tidsskr. **26**: 283–297. *f. 1–8.* 30 N 1904.

Clinton, G. P. The study of parasitic fungi in the United States. Trans. Mass. Hort. Soc. **1904**: 91–109. 1904.

Clute, W. N. *Adiantum Capillus-veneris* in Pennsylvania? Fern Bull. **12**: 121, 122. [D] 1904.

Clute, W. N. The fly amanita. (*Amanita muscaria.*) Am. Bot. **7**: 61–63. [D] 1904. [Illust.]

Clute, W. N. The Jamaica walking fern. (*Fadyenia prolifera.*) Fern Bull. **12**: 112, 113. [D] 1904. [Illust.]

Cocks, R. S. Notes from Louisiana. Fern Bull. **12**: 110, 111. [D] 1904.

Col, A. Recherches sur la disposition des faisceaux dans la tige et les feuilles de quelques Dicotylédones. Ann. Sci. Nat. Bot. VIII. **20**: 1–288. *f. 1–40.* N 1904.

Collins, F. S. Algae of the Flume. Rhodora **6**: 229–231. 16 D 1904.

Conard, H. S. Phyllody in *Nelumbo.* Trans. & Proc. Bot. Soc. Pa. **1**: 350, 351. *pl. 28.* 1904.

Cooke, E. & Schively, A. F. Observations on the structure and development of *Ephiphegus virginiana.* Trans. & Proc. Bot. Soc. Pa. **1**: 352–398. *pl. 29–32.* 1904.

gametophytes and fertilization. Proc. Wash. Acad. Sci. **6**: 1–202. *pl. 1–24.* 14 O 1904.

Filton, G. H. An addition to the fern-flora of Vermont. Rhodora **6**: 235, 236. 16 D 1904.

Fink, B. Further notes on cladonias — IV. *Cladonia verticillata.* Bryologist **7**: 85–88. *pl. 11.* 1 N 1904.

Fitzpatrick, T. J. The fern flora of Montana. Fern Bull. **12**: 97–101. [D] 1904.

Fitzpatrick, T. J. Notes on the ferns of Washington. Fern Bull. **12**: 108–110. [D] 1904.

Foster, A. S. The broad wood-fern in Washington. Fern Bull. **12**: 103, 104. [D] 1904.

Ganong, W. F. New precision-appliances for use in plant physiology. Bot. Gaz. **37**: 302–306. 16 Ap 1904.

Grout, A. J. Hepatics with hand-lens. Bryologist **7**: 89–98. *f. 1–15.* 1 N 1904.

Grout, A. J. Spore distribution in *Buxbaumia.* Bryologist **8**: 3, 4. 27 D 1904.

Hahne, A. H. Forking ferns. Fern Bull. **12**: 114–118. [D] 1904.

Halley, R. A. Dr. Augustin Gattinger, the pioneer botanist of Tennessee. 1–28. *portrait.* Nashville, Tenn., 1904.

Reprinted from the American Historical Magazine for April, 1904.

Harper, R. A. Hamilton Greenwood Timberlake. Trans. Wis. Acad. **14**: 690–693. *portrait.* 1904.

Harshberger, J. W. The relation of ice storms to trees. Trans. & Proc. Bot. Soc. Pa. **1**: 345–349. 1904.

Hollick, A. *Phanerogamia.* Md. Geol. Surv. Miocene, 483–486. *f. 1.* 1904.

New species are described and figured in *Quercus*, *Ulmus*, *Caesalpinia*, *Rhus* and *Pieris*.

Holm, T. Studies in the *Cyperaceae*, XXI. New or little known species of *Carex.* Am. Jour. Sci. IV. **17**: 301–317. *f. 1–13.* Ap 1904.

Includes descriptions of 15 new species, all American, and chiefly from Yukon.

Holway, E. W. D. Notes on *Uredineae*, III. Jour. Myc. **10**: 228. 14 O 1904.

Howe, M. A. Report on a trip to Europe. Jour. N. Y. Bot. Gard. **5**: 217–222. *f. 40, 41.* D 1904.

Jack, J. G. The Arnold Arboretum. Trans. Mass. Hort. Soc. **1904**: 59–75. 1904.

Jeffrey, E. C. A fossil *Sequoia* from the Sierra Nevada. Bot. Gaz. 38: 321–332. *pl. 18, 19.* 19 N 1904.

Jellett, E. C. Germantown, old and new: its rare and notable plants. [Ed. 2.] 1–114. [Germantown, Pa.,] 1904. [Illust.]
Relates chiefly to the trees and garden plants of Germantown.

Kaufman, P. Random notes. Am. Bot. **7**: 46–48. [N] 1904.

Kraemer, H. The origin and nature of color in plants. Proc. Am. Phil. Soc. **43**: 257–277. 1904.

Life, A. C. An abnormal *Ambrosia.* Bot. Gaz. **38**: 383, 384. *f. 1–3.* 19 N 1904.

Lovell, J. H. Spiders and flowers. Am. Bot. **7**: 45, 46. [N] 1904.

Macfarlane, J. M. The history, structure and distribution of *Sarracenia Catesbaei* Ell. Trans. & Proc. Bot. Soc. Pa. **1**: 426–434. 1904.

MacKay, A. H. Fungi of Nova Scotia: a provisional list. Proc. & Trans. Nova Scotian Inst. Sci. **11**: 122–143. Au 1904. [Illust.]

MacMillan, C. Note on some British Columbia dwarf trees. Bot. Gaz. **38**: 379–381. *f. 1–13.* 19 N 1904.

Maxon, W. R. Notes on American ferns: VII. Fern Bull. **12**: 101–103. [D] 1904.

Milliken, J. A review of Californian *Polemoniaceae.* Univ. Calif. Publ. Bot. **2**: 1–71. *pl. 1–11.* 10 My 1904.
Includes descriptions of new species in *Gilia* (3) and *Linanthus* (3).

Morgan, A. P. *Pyrenomycetes* scarcely known in North America. Jour. Myc. **10**: 226–228. 14 O 1904.

Nelson, E. Some western species of *Agropyron.* Bot. Gaz. **38**: 378. 19 N 1904.

Newcombe, F. C. Klinostats and centrifuges for physiological research. Bot. Gaz. **38**: 427–434. *f. 1–3.* 20 D 1904.

Olsson-Seffer, P. The place of Linnaeus in the history of botany. Jour. Bot. **42**: 262–269. 1 S 1904.

Parish, S. B. New or unreported plants from Southern California. Bot. Gaz. **38**: 459–462. 20 D 1904.
Includes new species in *Horkelia*, *Drymocallis*, *Gentiana*, *Aster* and *Senecio.*

Parish, S. B. A preliminary synopsis of the Southern California *Cyperaceae.* Bull. So. Cal. Acad. Sci. **3**: 141–143. 7 D 1904.

Phelps, O. P. New stations for two rare Connecticut ferns. Fern Bull. **12**: 118. [D] 1904.

Phillips, O. P. A comparative study of the cytology and movements of the *Cyanophyceae*. Trans. & Proc. Bot. Soc. Pa. **1**: 237–335. *pl. 23–25*. 1904.

Puttemans, A. Contribution à l'étude de la fumagine des Caféiers. Bull. Soc. Myc. France **20**: 152–154. *pl. 10*. 20 Jl 1904.

Includes descriptions of new species in *Capnodium* and *Limacina* from coffee cultivated at Sao Paulo, Brazil.

Puttemans, A. Sur la maladie du Caféier produite par le *Stilbella flavida*. Bull. Soc. Myc. France **20**: 157–164. *pl. 11*. 20 Jl 1904.

Based on material from Sao Paulo, Brazil.

Rendle, A. B. Mr. Hesketh Pritchard's Patagonian plants. Jour. Bot. **42**: 321–334. *pl. 465*. 1 N 1904; 367–378. 1 D 1904.

Includes descriptions of 18 new species in 14 genera.

Richards, H. M. A case of irregular secondary thickening. Torreya **4**: 181–184. *f. 1, 2*. 30 D 1904.

Robinson, B. L. A new sheep-poison from Mexico. Bot. Gaz. **38**: 376–378. 19 N 1904.

With a description of *Bouchetia arniatera* sp. nov.

Safford, W. E. Extracts from the note-book of a naturalist on the island of Guam. — XX. Plant World **7**: 163–169. *pl. 9, 10*. Jl 1904; — XXI. Plant World **7**: 189–195. *pl. 11*. Au 1904; — XXII. Plant World **7**: 213–220. *pl. 13*. [O] 1904; — XXIII. Plant World **7**: 237–245. *pl. 14*. [N] 1904; — XXIV. Plant World **7**: 261–268. *pl. 16*. [D] 1904.

Sargent, C. S. Horatio Hollis Hunnewell. Proc. Am. Acad. Arts & Sci. **39**: 656–658. Je 1904.

Schneck, J. *Asplenium Ruta-muraria* on the towers of Milan cathedral. Fern Bull. **12**: 118, 119. [D] 1904.

Sempers, J. F. Honey. Am. Bot. **7**: 64–66. [D] 1904.

Shafer, J. A. The American sennas. Torreya **4**: 177–181. *f. 1, 2*. 30 D 1904.

With a description of *Cassia Medsgeri* sp. nov.

Shull, G. H. Place-constants for *Aster prenanthoides*. Bot. Gaz. **38**: 333–375. *f. 1–18*. 19 N 1904.

Smith, A. M. William Starling Sullivant. Bryologist **8**: 1–3. *portrait*. 27 D 1904.

Sommier, S. Della introduzione fortuita di piante esotiche, a proposito di alcuni avventizie nuove o rare per la flora italiana. Bull. Soc. Bot. Ital. **1904**: 115–126. 10 My 1904.

Most of the plants mentioned as adventive in Italy are natives of South America.

Sumstine, D. R. The *Boletaceae* of Pennsylvania. Torreya **4**: 184, 185. 30 D 1904.

Warnstorf, C. Neue europäische und exotische Moose. Beih. Bot. Centralbl. **16**: 237–252. *pl. 10, 11.* 1904.

Includes descriptions of 2 new American species of *Spagnum*: *S. roseum*, from Brazil, and *S. Harperi*, from Georgia.

Waters, C. E. *Asplenium ebeneum proliferum.* Rhodora **6**: 210, 211. 29 O 1904.

Watson, C. H. The structure and relation of the plastid. Trans. & Proc. Bot. Soc. Pa. **1**: 336–344. *pl. 26, 27.* 1904.

Weberbauer, A. *Pourretia gigantea.* Bol. Soc. Geogr. Lima, **15**: 78–81. 31 Mr 1904.

West, G. S. West Indian freshwater algae. Jour. Bot. **42**: 281–294. *pl. 464.* 1 O 1904.

Includes descriptions of 9 new species in 8 genera.

Wetzstein, A. The white prickly poppy in northwestern Ohio. Plant World **7**: 277, 278. [D] 1904.

Wilson, P. Some introduced plants in Cuba. Torreya **4**: 188. 30 D 1904.

Winton, A. L. The anatomy of edible berries. Am. Jour. Pharm. **76**: 428–441. *f. 1–9.* S 1904; 533–545. *f. 1–21.* O 1904.

Reprinted from Conn. Agric. Exp. Sta. Rep. **26**: 288–313. *f. 1–21.* 1903.

Woodward, H. C. Cream-colored jewel-weeds. Am. Bot. **7**: 29, 30. [O] 1904.

Woolson, G. A. *Nephrodium pittsfordensis.* Fern Bull. **12**: 106–108. [D] 1904.

Zang, W. Die Anatomie der Kiefernadel und ihre Verwendung zur systematischen Gliederung der Gattung *Pinus.* 1–48. *pl. 1–5.* Giessen, 1904.

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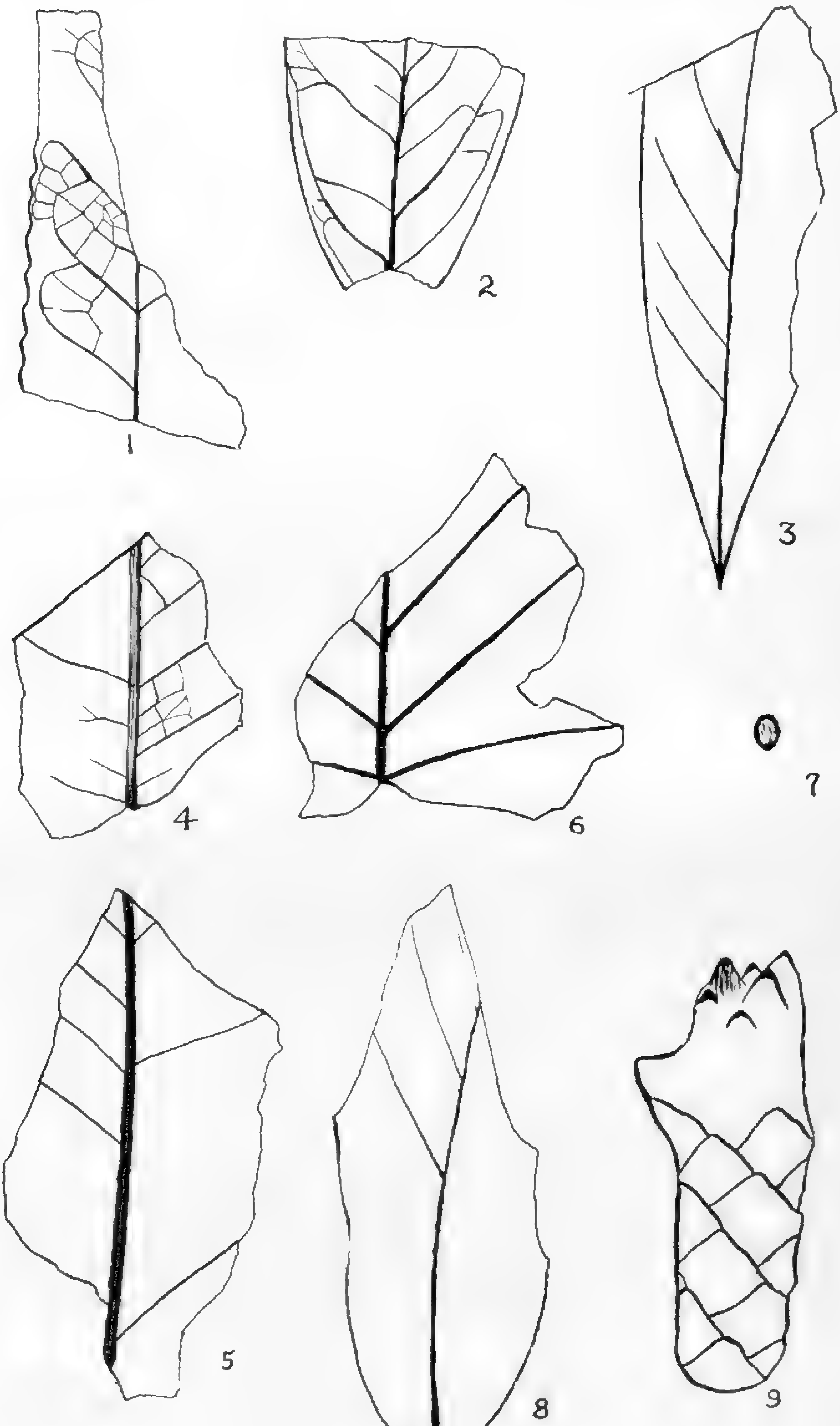

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BULLETIN

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FEBRUARY, 1905

Mechanical adjustment of the suaharo (Cereus giganteus) to varying quantities of stored water

Effie Southworth Spalding

(With plates 3 and 4)

Among the desert plants of the southwestern United States that are provided with a well-developed system for water-storage, certain cacti, particularly those of columnar form, are conspicuously fluted with strong ribs and corresponding furrows that extend from base to apex of the stem. This structure naturally suggests a ready adjustment of the plant, by a bellows-like action of its ribs and furrows, to changes in bulk due to varying amounts of stored water. It is obvious, however, that such an adjustment, if it satisfies the requirements of successful adaptation, must not impair the efficiency of the general mechanical system; since these plants, rising like a columnar water-tank, often to the height of 50 or 60 feet, from a narrow base, are subjected to the force of high winds from every point of the compass.

To ascertain whether this bellows-like action actually takes place, a series of measurements and observations were undertaken at the Desert Laboratory during the winter of 1903–4. These were begun by the resident investigator, Dr. W. A. Cannon, and, at his suggestion, were afterwards carried out and extended by myself.

An inspection of a cross-section of the stem of a giant cactus will show a heavy band of thick-walled subepidermal tissue, which is exceedingly strong and elastic. Beneath this is a band of thin-walled chlorophyl-cells, and all the tissue between this and the

[The Bulletin for January (32: 1–55, *pl. 1, 2*) was issued 23 F 1905.]

ring of fibro-vascular bundles is made up of thin-walled water-storing cells.

From the construction it seems evident that a change in bulk corresponding to varying quantities of water contained in this tissue could hardly affect the central mechanical cylinder; but would be far more likely to manifest itself externally by expansion or contraction of the circumference, effected by folding or unfolding of the ribs and furrows.

To determine whether this actually takes place, measurements were made by marking with India ink points opposite each other on adjacent ribs, and, by means of callipers, measuring the distance between them at intervals of a day or more. Opposite points at the bases of the ribs were also marked in the same way, and the thickness of the ribs between these points measured by callipers. Finally a wire was placed around some of the plants, with a coiled spring, partially stretched, inserted between its ends. Variation in the length of the spring thus indicated any change that took place in the circumference. It was found that these three sets of measurements always corresponded. The ribs and furrows expanded and contracted at the same time, and their action was coincident with a corresponding increase or decrease in the circumference. For the sake of convenience, the comparisons which follow will be restricted to the measurements of the furrows.

To exhibit their changes graphically, curves were constructed, distances between ribs being laid off on the vertical axis, each space representing $\frac{1}{64}$ inch, and time being represented on the horizontal axis, each space representing one day. (In the accompanying diagrams every fifth line only is shown, so that each vertical space represents $\frac{5}{64}$ inch, and each horizontal space 5 days.) The English instead of the metric scale was employed, merely because the finest rule available at the time was in the former system. The measurements were all made with blunt callipers, and often when the cacti were swaying in the wind, so that absolute accuracy to $\frac{1}{64}$ of an inch was not always attainable; for all the comparisons made, however, it is believed that the curves are substantially correct.

The changes in width which the furrows exhibited will readily be understood from the curves constructed from measurements of

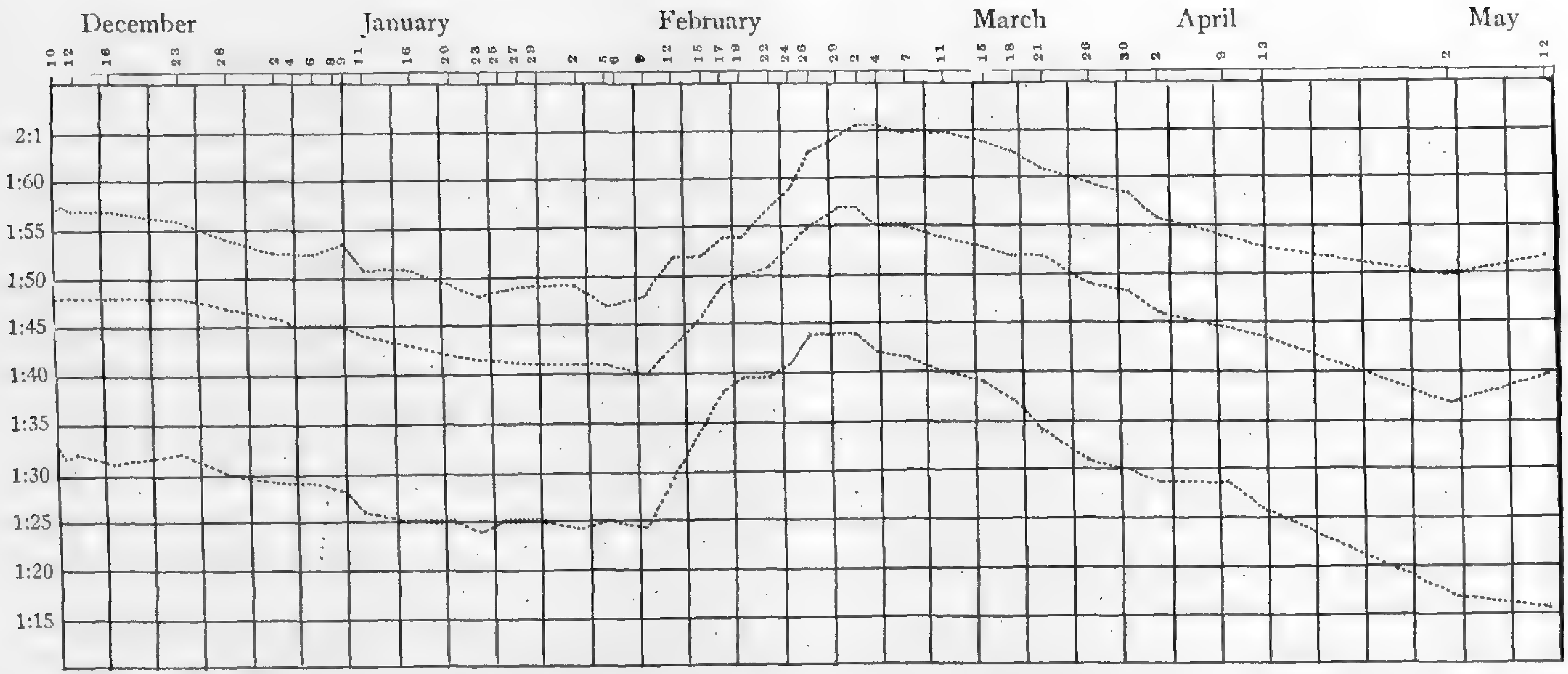

FIGURE 1. Curves derived from measurements of suaharo number 1. Rain, January 8 (0.2 in.), February 6 (0.54 in.), and May 2 (1 in.). The other days mentioned are the ones on which measurements were taken. In this and the following diagrams, each vertical space represents $\frac{5}{64}$ inch, and each horizontal space 5 days.

suaharo number 1 (*figure 1*), which may be regarded as in most respects a typical individual. This plant (*plate 3*) was about 12 feet high, in good condition, and the observations upon it were begun earlier and continued longer than on any other, thus covering more varied conditions than in any other case. The furrows marked were all on the north side, the points selected for measurement being about halfway from the ground to the top of the plant; and consequently the curves constructed from these measurements show a much greater similarity than those for which the measurements were made at different heights and on different sides.

The observations were begun December 10. During the cold, dry weather which followed, the edges of the furrows slowly approached, one of them losing $\frac{10}{64}$ of an inch in width. On February 6 there was a rain of 0.54 of an inch,* and this was followed by warmer weather. After this rain, the furrows expanded rapidly for nearly a month. This period was probably prolonged somewhat as a result of some water being poured out near the plant in the latter part of February. About March 2 the furrows began to grow narrower, and this continued during the warm, dry weather of March and April. On May 2 and 3 there was a rain of about one inch and slight expansion of two furrows followed. It is not known whether this expansion continued, as the observations were now brought to a close.

Inspection of the curves shows at a glance that expansion and contraction of the stem, indicated by varying distances between adjacent ribs, is correlated with water-supply; a conclusion abundantly confirmed by observations upon other individuals, especially numbers 2 and 9, which were furnished with water from artificial sources.

Number 2 was situated about eleven feet from the end of the pipe that carried off the waste water from the laboratory, and the slope of the ground was such that the water flowed close around its base. On March 12 this was changed, a trough carrying the water past the plant and emptying it on the slope below, though some water still probably reached the roots of the plant through leakage of the trough.

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*The statements as to amount of rain are all based on the records kept at the University of Arizona, some three miles from the Desert Laboratory, and 200 feet below it.

The first observations on this plant were made some three months after the opening of the laboratory, and judging from its full appearance and from other experiments, it is probable that the first effect of the water had been to cause an expansion of the stem. By the time observations were begun this had entirely ceased, but, as will be seen, it is evident that the presence of water in the soil was still exerting an influence. From January 9 to February 6, while the furrows of number 1 contracted $\frac{6}{64}$, $\frac{5}{64}$ and $\frac{4}{64}$ of an inch, two furrows of number 2 contracted only $\frac{1}{64}$ and a third $\frac{4}{64}$ of an inch (*figure 2*). The difference in the effect of the rain of February 6 was even more marked. While the furrows of number 1

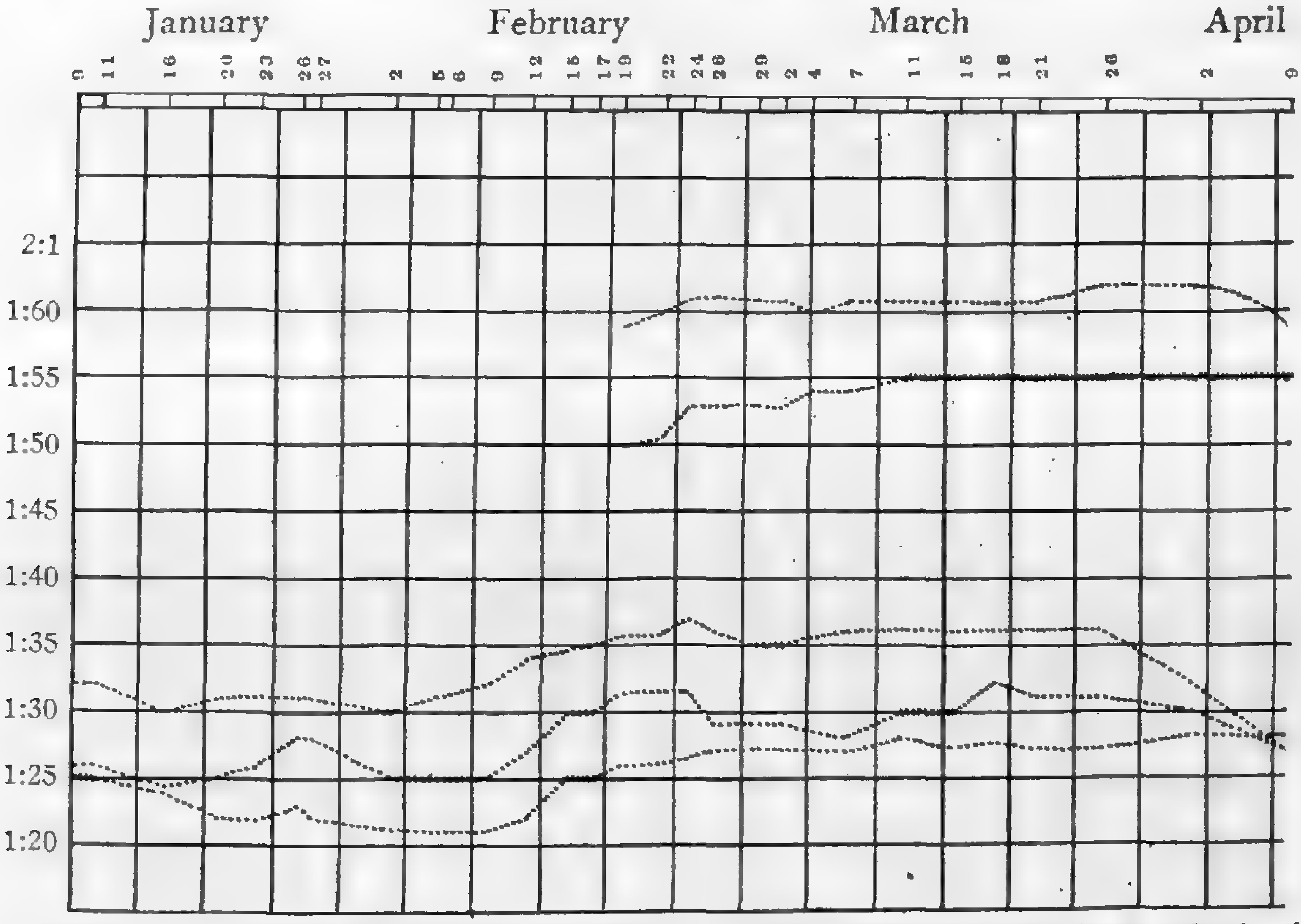


FIGURE 2. Curves for suaharo number 2. The measurements from which the three lower curves were derived were made on comparatively young branches, those for the two upper on lower and older parts of the stem. Rain, February 6 (0.54 in.).

showed an increase of $\frac{17}{64}$ to $\frac{20}{64}$ of an inch, those of number 2 only increased $\frac{6}{64}$ to $\frac{7}{64}$ of an inch, indicating that previous to the rain the cells of number 2 were much nearer their limit of expansion than those of number 1. It is evident then that the plant was able to avail itself to a considerable extent of the waste water of the laboratory, notwithstanding the large quantity of alkaline salts and other chemicals carried by it; and this is farther shown by its behavior after the period of expansion had ceased. Up to March 26, when the other cacti had been contracting for over three weeks, number 2 remained practically stationary. After this, two of three furrows that were marked shrank; but it was now receiving very little water.

The correlation of the expansion and contraction of the stem with its water-supply is demonstrated still more clearly by the measurements of another individual designated as number 9. On February 15, when the cacti under observation were all in process of expansion, this plant was selected and watered in order to ascertain whether by this means the period of expansion could be prolonged. Until March 4 it was given 8 to 12 gallons of water three times a week; after that, it was watered once a week until

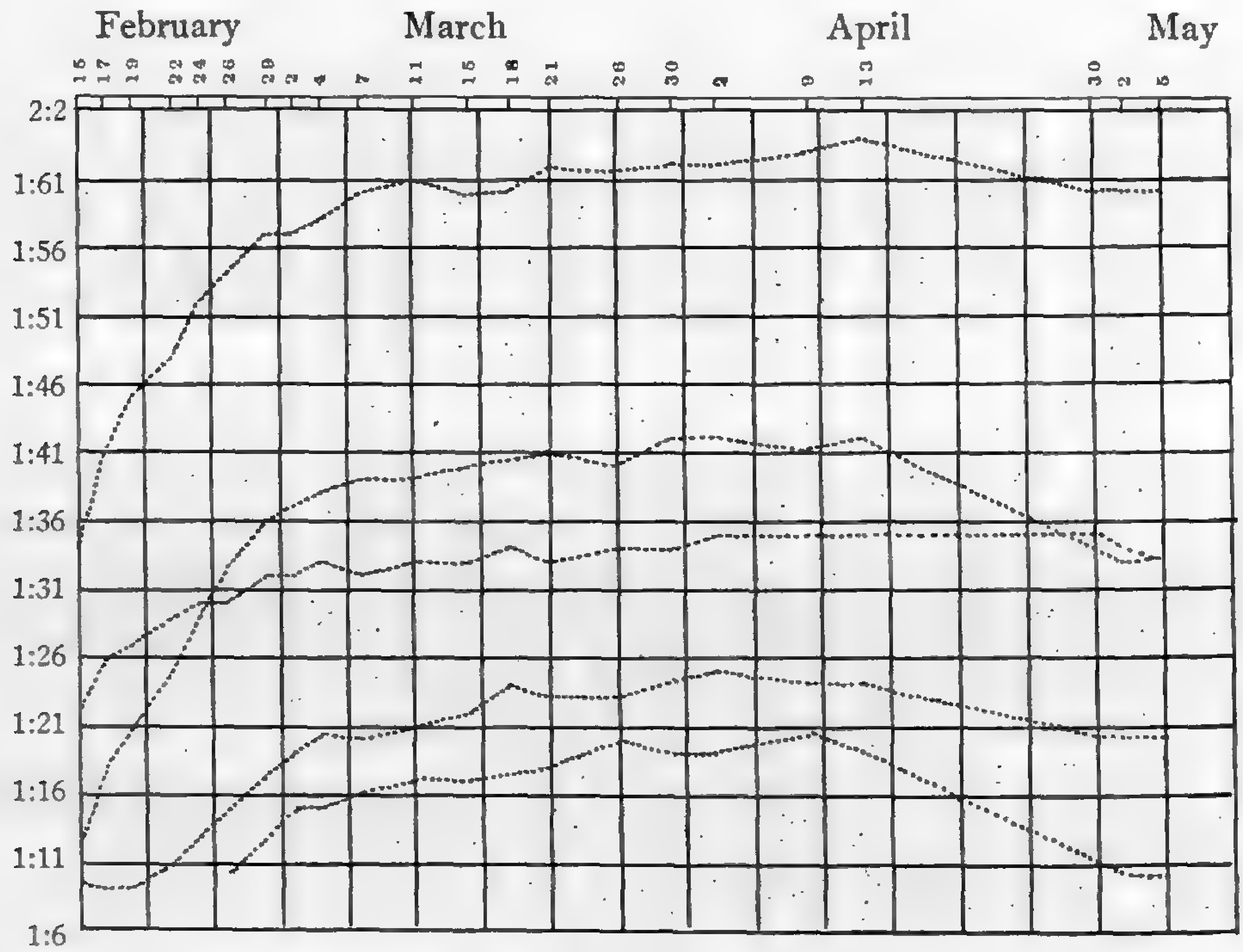


FIGURE 3. Representative curves derived from measurements of suaharo number 9. The lowest curve represents the variations in the thickness of a rib.

April 13. The water used was the ordinary tap-water charged with alkaline salts.

The behavior of the plant is shown by the curves in *figure 3*. It expanded very rapidly until about March 11, from one to three weeks after the other cacti had begun to contract. From then until between April 9 and 13 the furrows remained at about the same width while those of the others, except number 2, were contracting, some of them quite rapidly.

During this time, however, one cactus, number 4, accidentally received a thorough wetting by overflow and subsequent leakage from the water tank. It immediately stopped contracting, and in the next few days all the furrows marked expanded from one sixty-fourth to ten sixty-fourths of an inch (*figures 8* and *9, curve 4*.) After the soil had dried the furrows again contracted.

Nothing could show more clearly the relation between water-supply and the expansion and contraction of the trunk of the giant cactus than a comparison of the behavior of these artificially watered plants and that of number 1. Some idea of the limit of expansion can be gained from number 9, which after expanding for about five weeks, remained nearly stationary for a month, though the plant was well watered once a week. This would also indi-

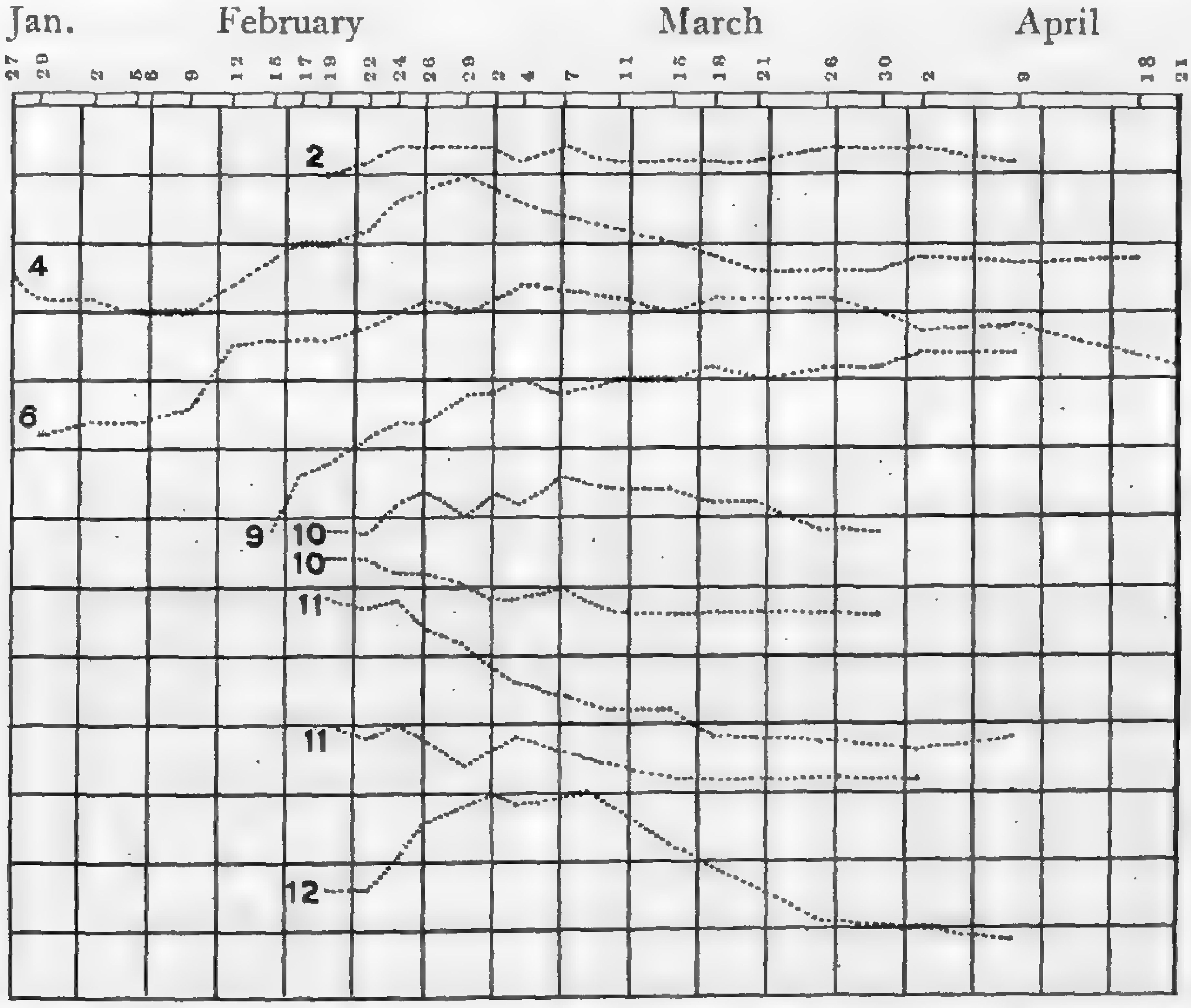


FIGURE 4. Curves derived from measurements near the bases of different plants. In this and the last two figures, in order to avoid confusion, the width of the furrows was ignored in placing the curves on the metric paper; and the figures refer to the number of the plant from which the curve was derived. Rain, February 6 (0.54 in.).

cate that the expansion which took place was the result of the absorption of water by the water-storing cells of the plant, and is not to be referred to growth.

The other suaharos that were measured—designated 6, 7, 10, 11, 12—agree substantially with what has already been stated regarding number 1. Two bisnagas—numbered 5 and 8—showed the same phenomena as the suaharos, but on a smaller scale.

During the observations, it became evident that while the plant as a whole responded in the way described to variations in its water-supply, different parts of the stem were affected in different degrees, and to such an extent that one furrow might even be contracting while another on the same plant was expanding. These facts are most evident from the records of plants that were not watered.

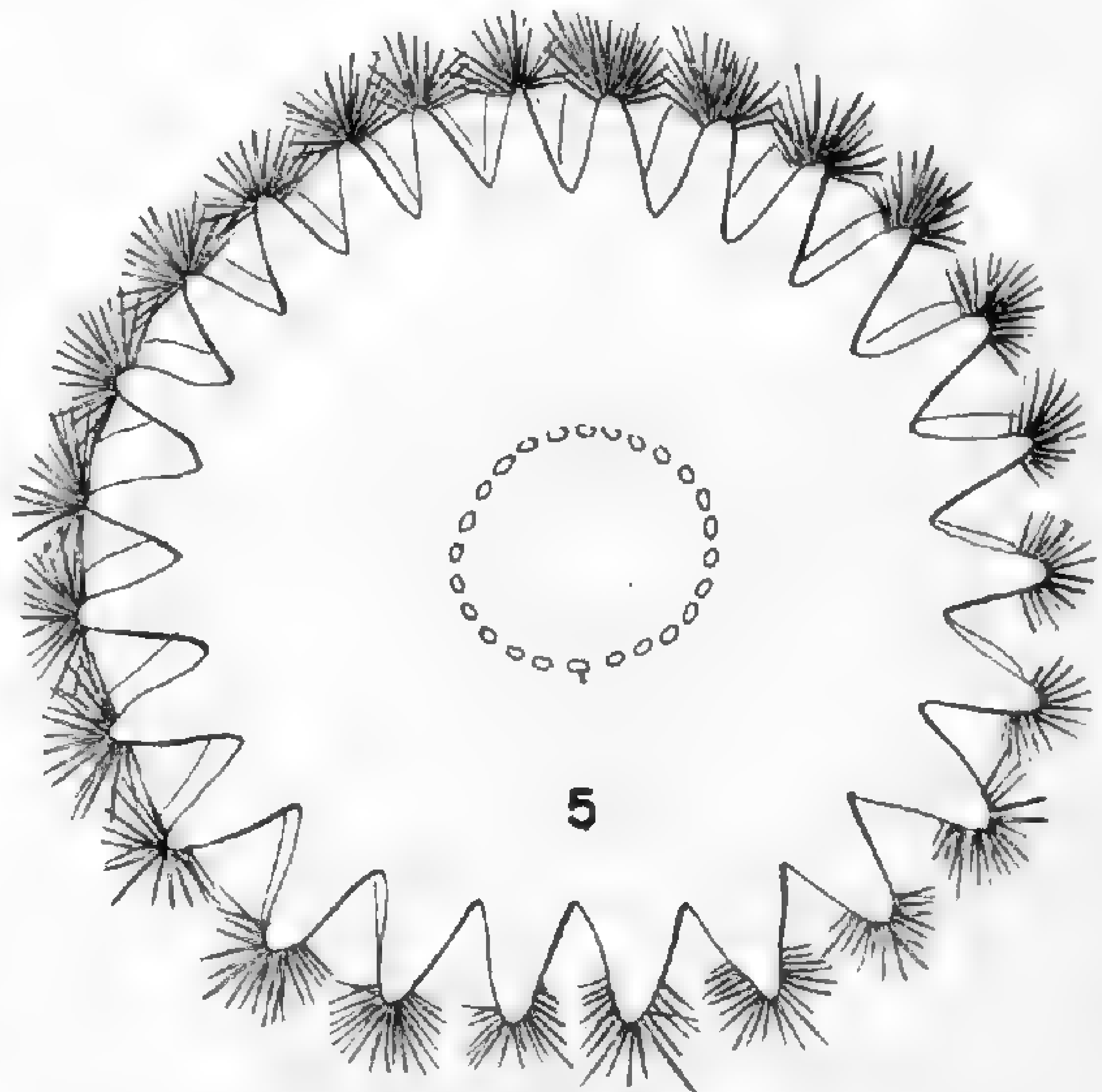
The lowest points at which measurements were made always showed a slow rate of change, and for a few inches below the apex the width of the furrows was stationary. Although observations were not sufficient to demonstrate any law as to comparative rate of change in different parts of the stem, a comparison of the curves in *figure 4* with those of any other set given will show that the variation near the base is less than higher up on the trunk.

This difference in the rate of change at various heights of the stem is no doubt mainly due to the different proportion of mechanical and water-storing tissue as shown in *figures 5*, *6* and *7* representing sections taken at 8 feet, 5 feet, and 15 inches from the base of a plant 9 feet high, but the different consistency of the cell-contents in the upper and lower parts of the stem may also be a factor.

The fact that no two furrows on the same stem vary exactly alike, even when measured at the same height, may also be understood by reference to the same figures. The contour of the sections shows that, beginning at the top, where the furrows are nearly equal all around the stem, their width and depth on opposite sides differ more as we pass to the lower portions. The deeper and narrower furrows are on the south; and the wider, shallower ones on the north side of the stem; and as we pass down to the suberized tissue near the base of the larger individuals the furrows all become obliterated and the ribs are finally marked only by rows of spines.

A comparison of the measurements from the north and south sides of the same plants (*figures 8* and *9*) shows that contraction is greater on the south than on the north side, and that while the southern furrows may begin to expand earlier, the northern ones expand longer. This difference in action of the two sides corresponds with the configuration of the mature stem, and suggests an interesting inquiry regarding the combined influence of temperature and light in the production of the form in question. To ascertain this and to find to what extent temperature as a secondary factor is active in the expansion and contraction of the stem would require observations extending over several seasons.

It will be instructive, however, to compare the curves already discussed with the temperature record for a corresponding period. From January 8 to 14 the mean temperature ranged from 42° to 56° F., and the effect of a rain of 0.2 of an inch was scarcely perceptible. From February 6 to 24 the mean temperature ranged from 47° to 68° F. and after a rain of half an inch the stems expanded steadily for three weeks. Later than this the mean temperature continued to increase during the period of observation, but, as already seen, the stems steadily contracted. It is noticeable, however, in comparing *figures 8* and *9*, that the furrows on the south side responded to the rain earlier than those on the north.



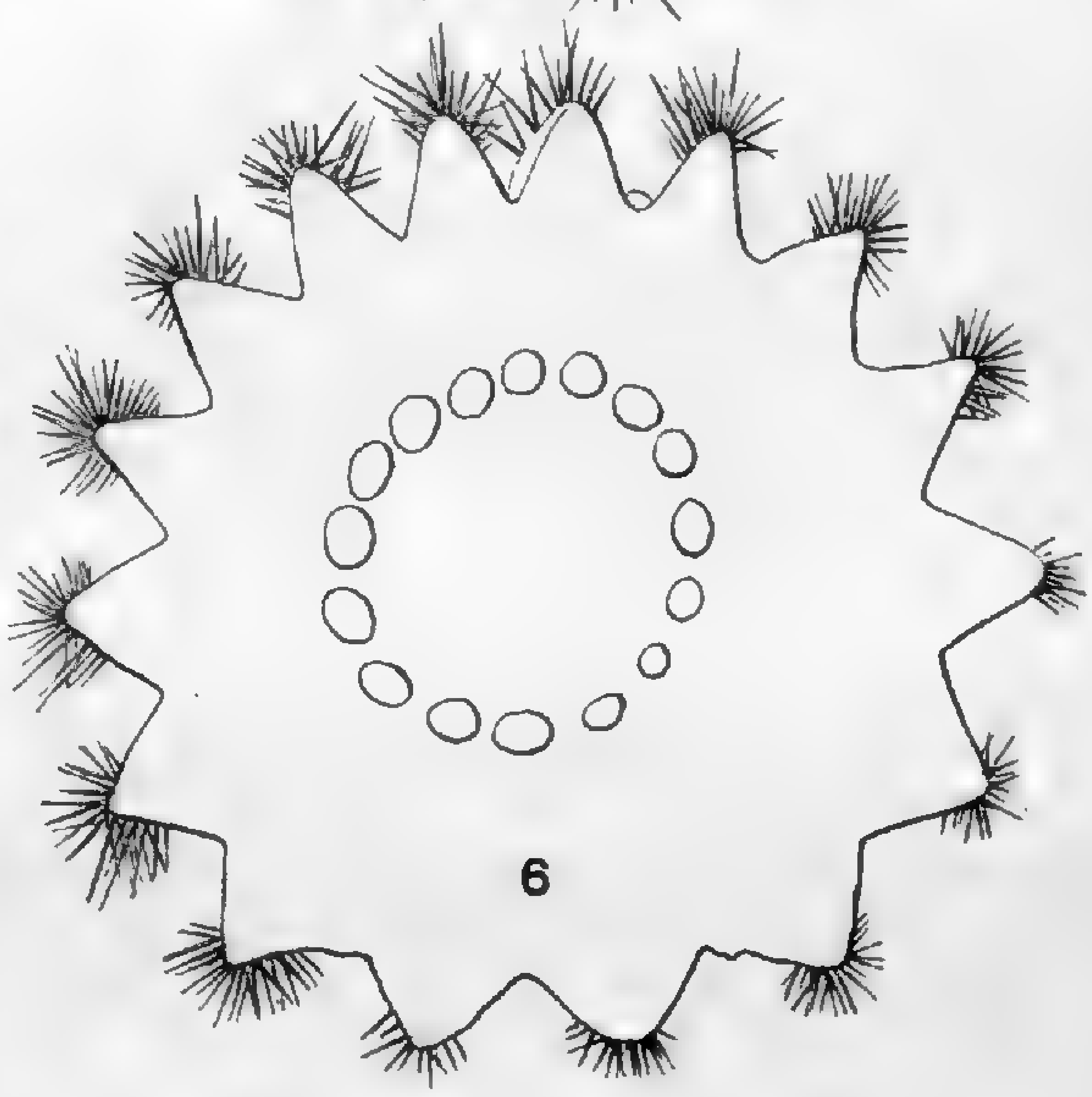


FIGURE 5. Section about 8 feet from the base, through the greatest diameter of the stem.

FIGURE 6. Section five feet from the base.

FIGURE 7. Section 15 inches from the base. The thin-walled, water-holding tissue becomes discolored almost immediately on contact with the air.

This very incomplete evidence indicates, as far as it goes, that temperature is an altogether subordinate factor, the effect of which, however, may increase or diminish that of water-supply.

Recurring again to the relation of the mechanical system to the processes of expansion and contraction, it would be difficult to imagine a more perfect arrangement for prompt and safe accommodation to variation in the large quantities of water held by these great columnar reservoirs. The strong central cylinder of fibrovascular bundles necessarily retains the relative position of its elements through all such variations; and the peripheral band of mechanical tissue is so disposed as to promptly adjust itself, by the simple change of position that has been described, to changes

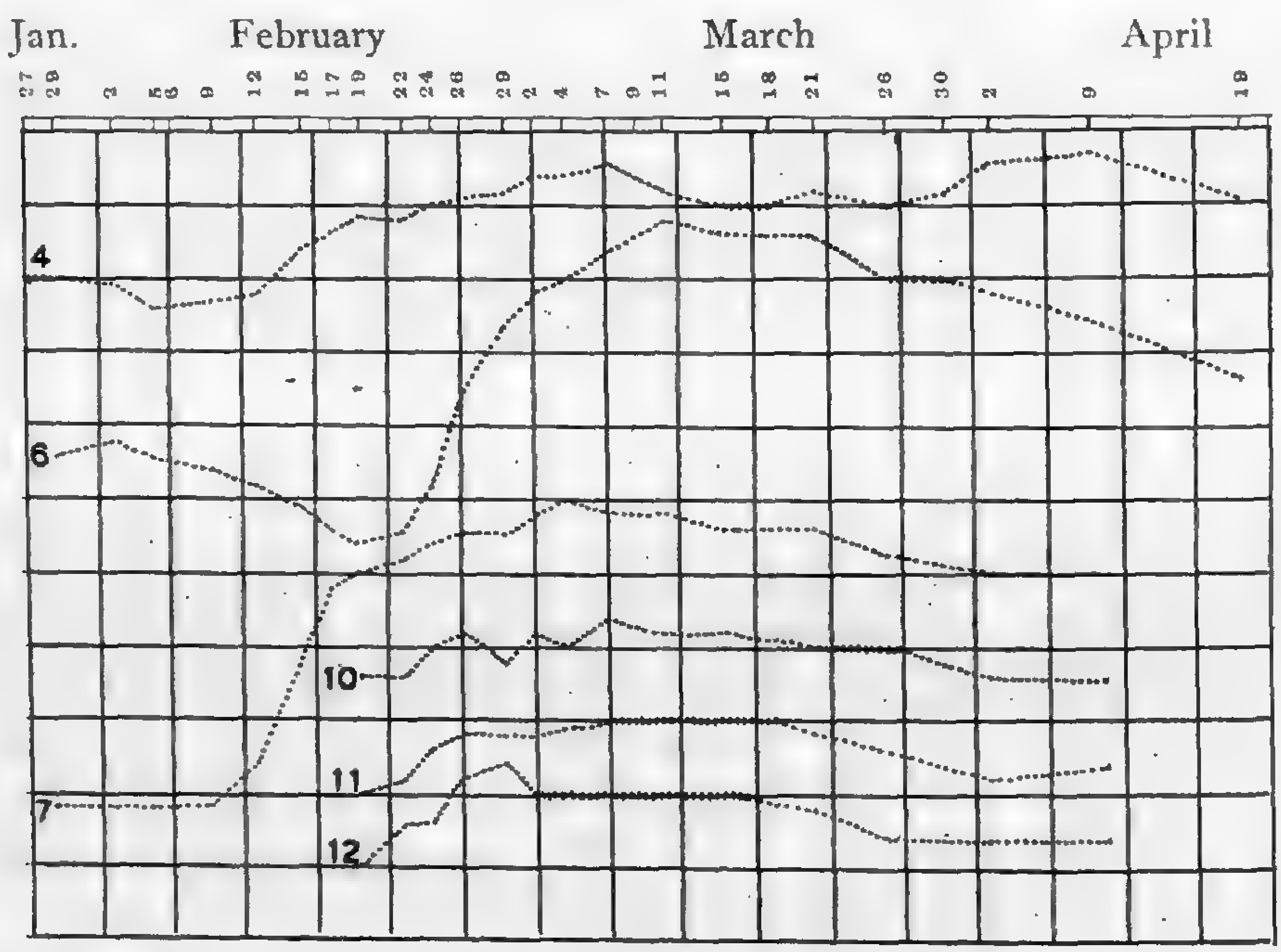


FIGURE 8. Six curves from as many different plants, each representing the variations of the furrow which faced nearest north. Rain, February 6 (0.54 in.).

in the bulk of the tissue which it surrounds. The circumference of the stem can therefore be increased or diminished without interfering in the slightest degree, as far as the present observations indicate, with the strength or efficient distribution of either the central or peripheral mechanical elements. That the change in girth may be considerable in a relatively short period is shown by the fact that some furrows of number 9, which was watered about two months, actually increased 35 per cent. of their original width, and that one furrow on a plant not watered expanded one-half an inch in ten days after the rain of February 6 (*figure 9, curve 7*).

To summarize briefly, the foregoing observations lead to the following results:

1. Changes in the circumference of the stem of the suaharo are accomplished by a bellows-like action of the ribs, which draw closer together as the circumference decreases, and move farther apart as it increases.

2. These movements are directly correlated with increase and decrease in the water supplied to the plant, and with corresponding changes in the quantity of water held by its storage tissue.

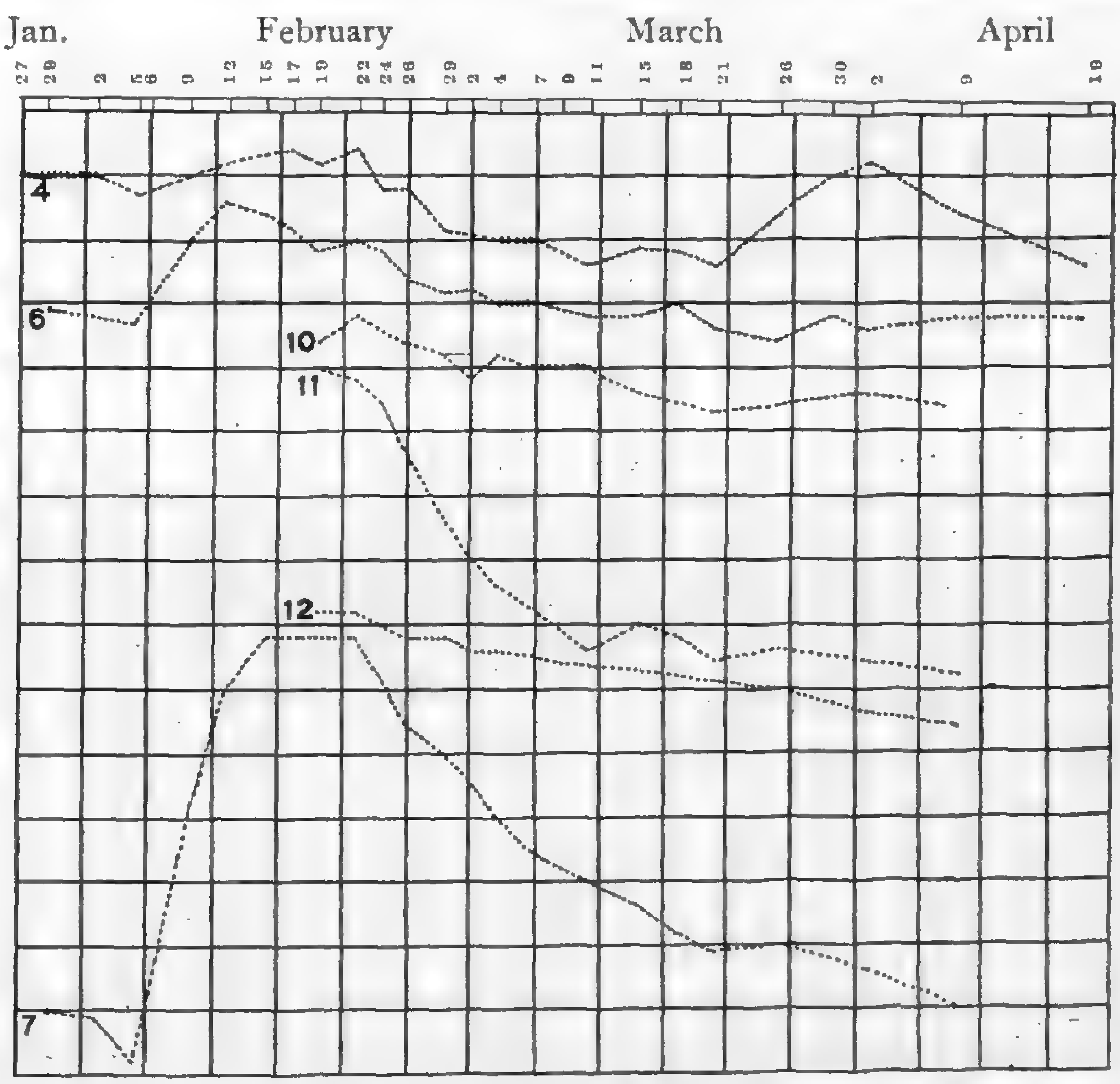


FIGURE 9. Six curves from the furrows facing nearest south on the same plants. The curves marked 4 in this figure and the preceding show the variation caused by an overflow of the water tank on March 18. Rain, February 6 (0.54 in.).

3. Variations in the circumference of the stem, due to changes of water-content, are not the same at all heights, but are least pronounced at the base and top.

4. In their expansion and contraction, the furrows on the north and south sides vary at different rates, which correspond with a difference in the configuration of the two sides.

5. Changes in the circumference of the stem effected by the mechanism described, while permitting free expansion and contraction of the water-storing tissue, leave the efficiency of the mechanical system unimpaired through all the vicissitudes to which the plant is subjected, and which it resists with a remarkable degree of success.

DESERT BOTANICAL LABORATORY,
TUCSON, ARIZONA.

Description of plates 3 and 4

PLATE 3. Suaharo number 1. Plant about 12 feet high, marked for observation about half way between base and apex.

PLATE 4. Suaharo number 4. A double-stemmed plant about six feet high, showing the very frequent enlargement of the stem near the top.

A new species of Lembosia

WILLIAM TITUS HORNE

Lembosia Rolfsii sp. nov.

Spots 1 to 2 cm. long extending partly or entirely around the stem, or several confluent. Young spots and margins only slightly discolored, pale yellowish-brown, becoming darker and

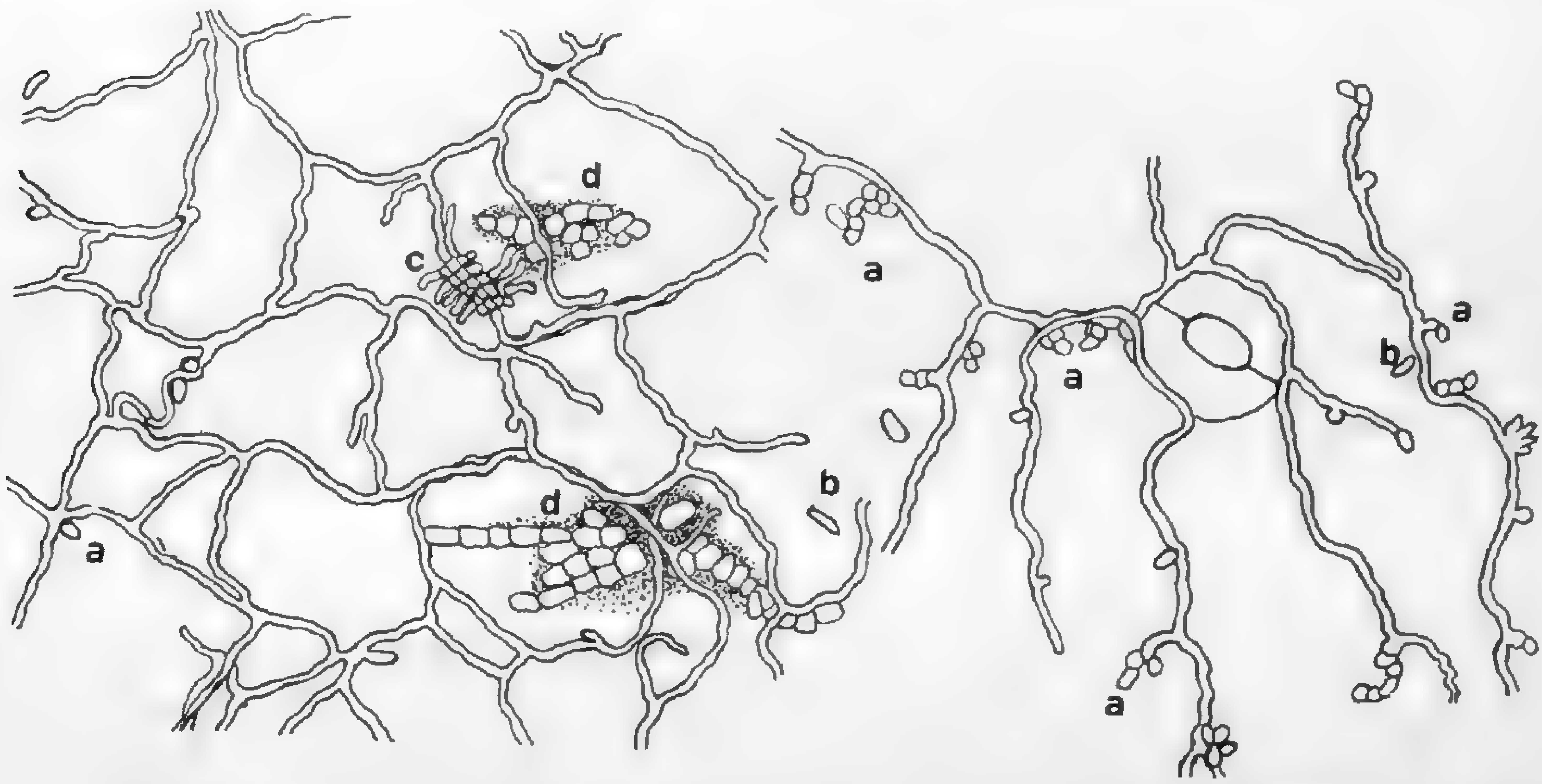


FIGURE 1. Two pieces of the mycelium on the cuticle near the margin of a spot, × 200. *a*, hyphopodia; *b*, detached conidia-like bodies; *c*, probably a young perithecium; *d*, structures of unknown significance lying below the cuticle.

specked with dark brown, or spot black. Mycelium of dark brown thick-walled hyphae without septae, freely branching and

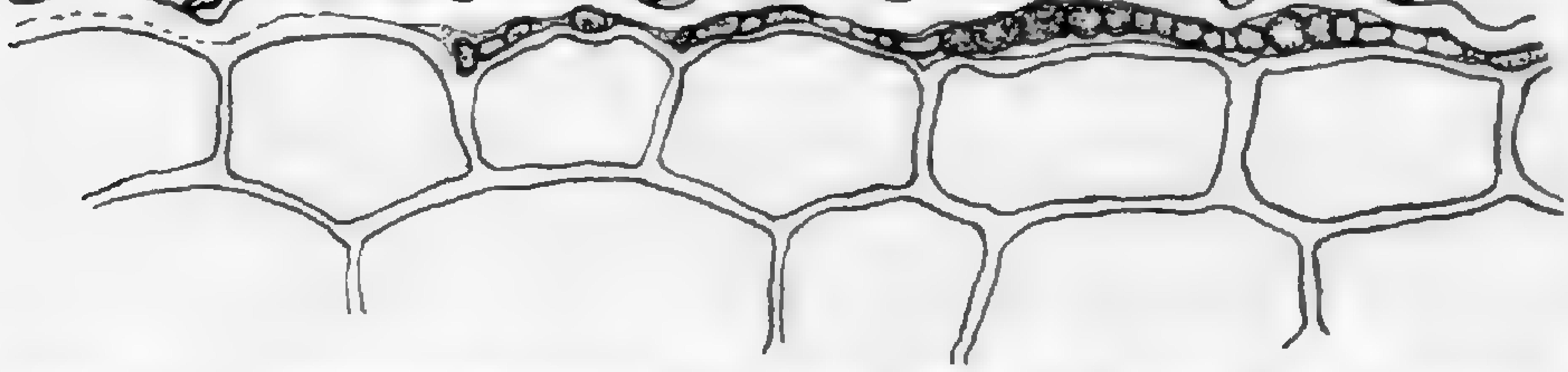


FIGURE 2. Transverse section 8 μ thick, mounted in balsam without stain, showing the position of the mycelium in hollows of the wavy cuticle and the position of the vesiculose mycelium-like growth between the cuticle and epidermal cells, × 300.

anastomosing, with numerous short haustoria-like branches (hyphopodia), forming a loose or dense network on the surface. Perithecia irregularly scattered in the spots, straight or variously-curved, or forked, about 160 μ broad by 350 μ to 1 mm. long or more, continuous below with the mycelium, usually a little broader than high, black. Asci broadly clavate to elongated ovate, narrowed and often curved at base, at maturity thickly coated, 20–40 by 8–15 μ, the apex becoming produced into a sac-like extension 10 to 15 μ long which is collapsed and brown about the ruptured apex after the escape of the spores. Paraphyses abundant, somewhat irregular, the tips a little broader and clavate, separating with difficulty, 2–3 μ broad, not exceeding the expanded tips of the asci. Sporidia most commonly 6 in an ascus (probably 8 in uninjured asci), biseriate or irregularly crowded, 2-celled, somewhat pointed, constricted at the middle, slightly unsymmetrical and curved, hyaline with one very large oil drop in each cell, becoming smoky-brown and nearly black with one or two small oil-drops in each cell, and the darker spores mostly a little smaller, 10–16 by 4–5 μ.

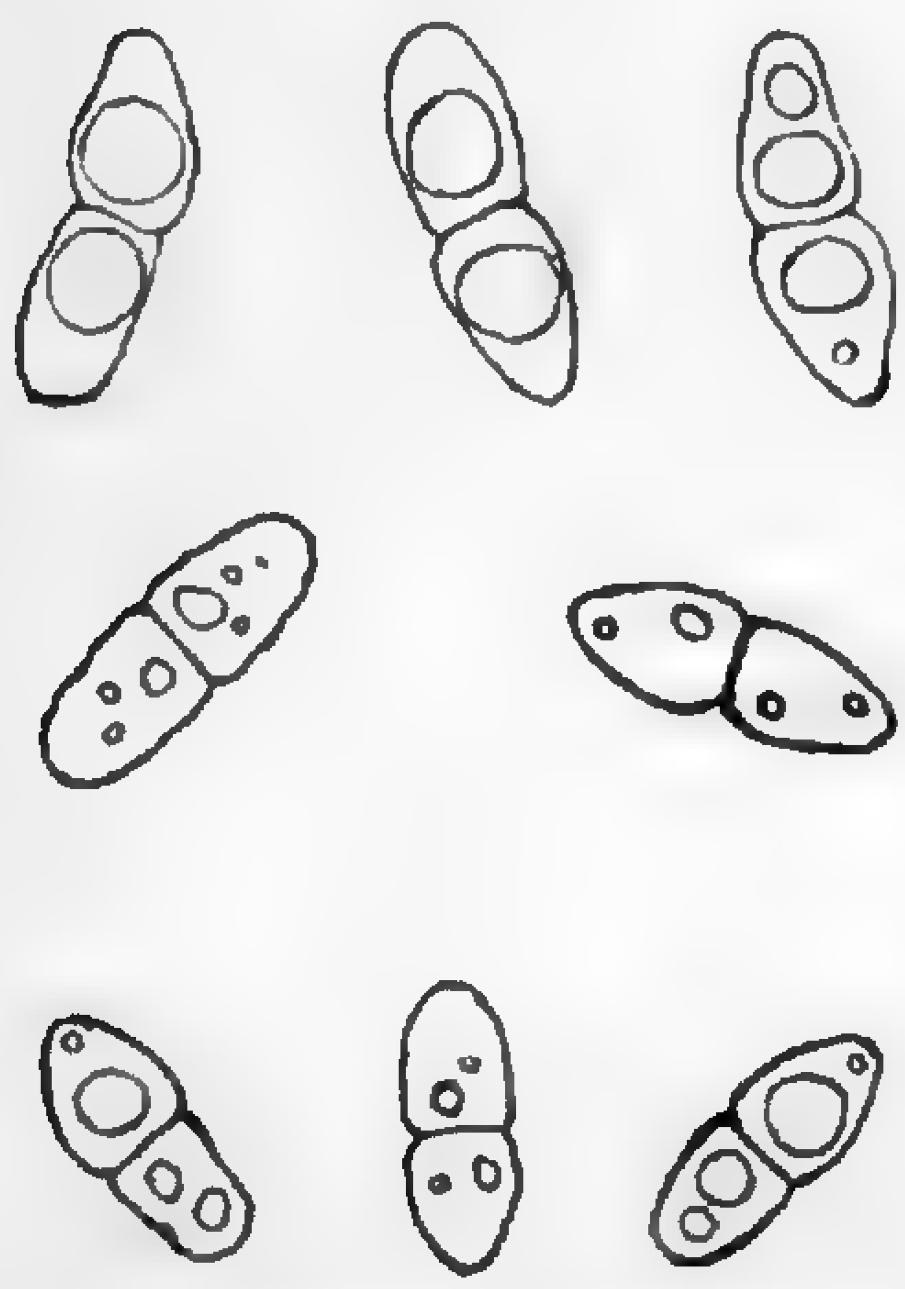
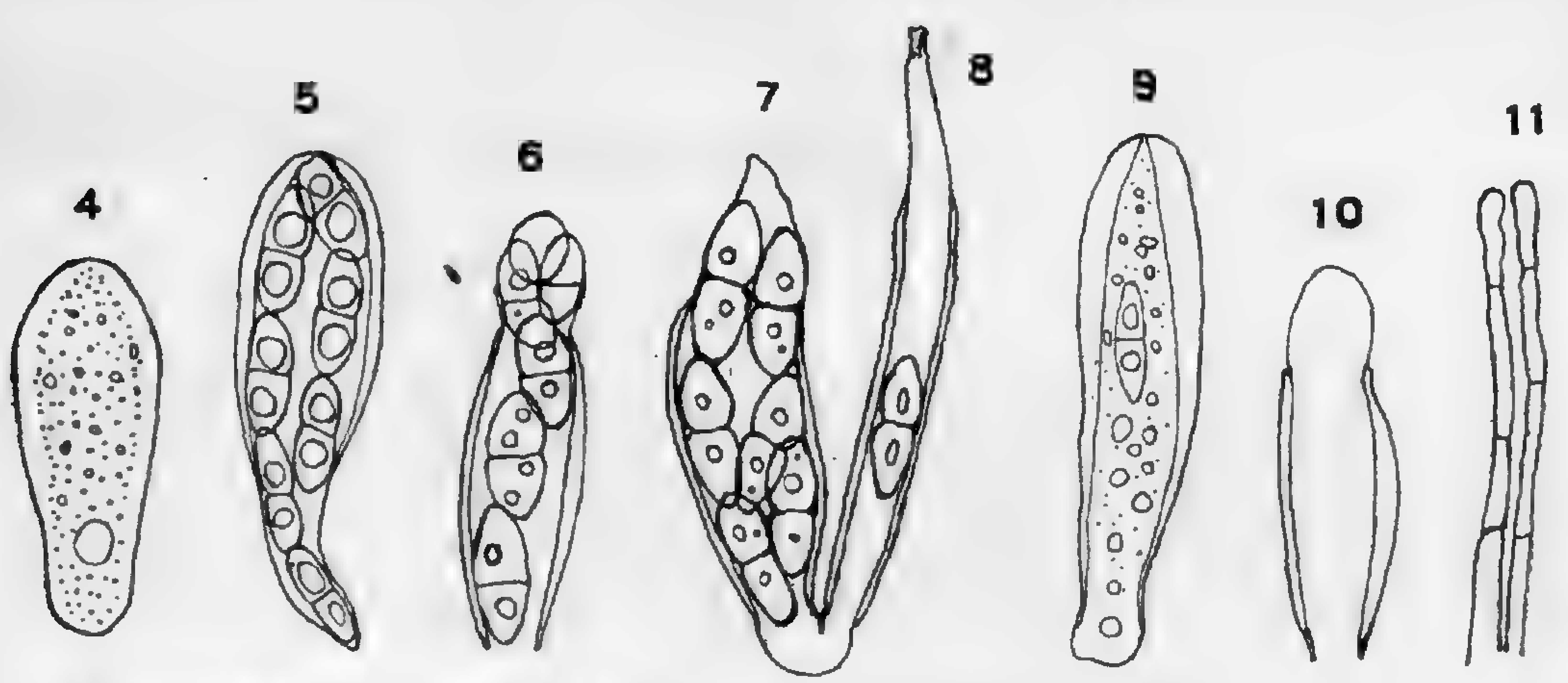


FIGURE 3. Spores, × 800; the three upper hyaline or nearly so, the five lower brown.

On green stems of *Vanilla planifolia* Andr., the cells of the host below the mycelium becoming gradually filled with brown granular material, and groups of brown vesicles appearing irregularly



FIGURES 4 to 10. Asci, × 800. FIGURE 11. Paraphyses, × 800.

between the cuticle and epidermal cells and finally extending down into the intercellular spaces for a short distance. The significance of these structures was not made out. The superficial mycelium was not seen to penetrate below the cuticle in a large number of microtome sections examined. Browning of the tissue is usually slight and was not seen distinctly for a depth of more than 1 mm.

The material studied was received from P. H. Rolfs, of the U. S. Subtropical Laboratory at Miami, Fla., in February, 1904.

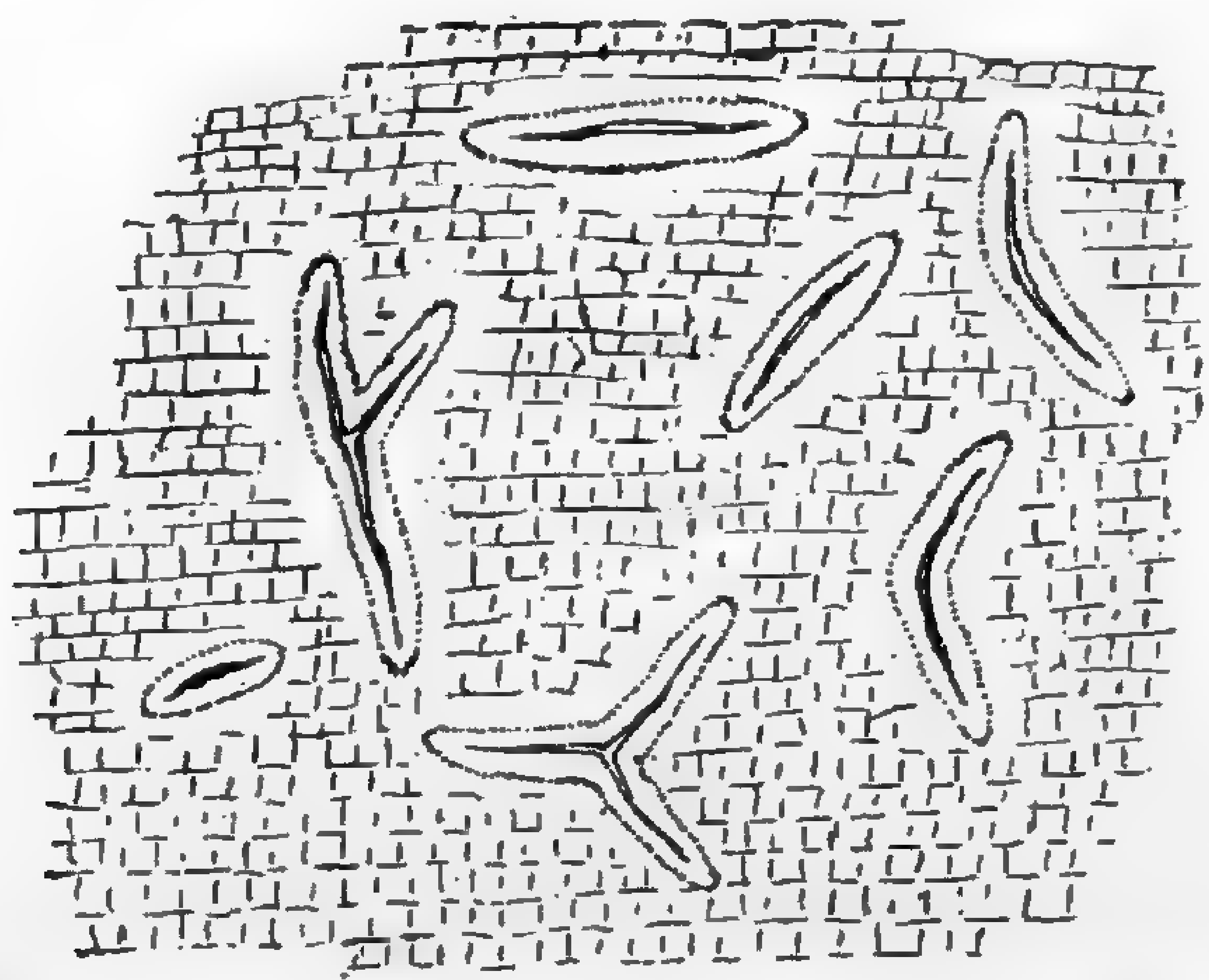


FIGURE 12. Part of spot with perithecia (partly diagrammatic), × about 10.

All attempts to make cultures from this material and from other lots kindly sent by Professor Rolfs failed, indicating that the species is probably a strict parasite.

On the names of three Jamaican species of Polypodium*

William Ralph Maxon

The first portion of the following notes is in advance of a more extended illustrated paper, the publication of which is unavoidably delayed, dealing with the species commonly associated with *Xiphopteris serrulata* (Sw.) Kaulf. under either *Polypodium* or *Xiphopteris*.

In 1804 † Schkuhr figured under the name *Grammitis myosuroides* a plant from Jamaica said to represent the Jamaican *Polypodium myosuroides* of Swartz (1788). Swartz himself in both the *Synopsis Filicum* and *Flora Indiae occidentalis* had so amended the original *Prodromus* (1788) description as to include the characters offered by Schkuhr's plant as represented in the plate; in fact, Schkuhr's plant was cited in the *Synopsis Filicum.* It is probable that the material possessed by both authors was very scant, and it is hardly to be wondered that two distinct species of this closely related group should, as we believe, have been thus confused. The strange feature is that with the more ample material since available for study, Schkuhr's plate should have been so universally misidentified and that the confusion of the several other species should have been so great.

For example: Hooker in 1861 described a *Xiphopteris Jamesoni* from Ecuador which is in reality identical with the true Jamaican *myosuroides* of Swartz (1788). The next year he incorrectly listed *myosuroides* Sw. as a synonym of *serrulatum* and cited Schkuhr's plate erroneously under *Polypodium setosum* (Kaulf.) Mett., an absolutely distinct species.

Jenman is the only writer who has clearly distinguished the several Jamaican species. He erred, however, in his use of specific

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* Published by permission of the Secretary of the Smithsonian Institution.

† [Mr. Maxon wrote *1809*, the title-page date, supposing that the plate was *unpublished* when cited by Swartz in 1806. Schkuhr's work, however, was issued in parts; and the first part, containing the page (9) and plate (7) cited, appeared in 1804. A copy of this part, with its original cover, is in the editor's library. — J. H. B., Ed.]

names. As a matter of fact, Schkuhr's plate represents a plant specifically distinct from the *myosuroides* of Swartz' *Prodromus;* but Jenman, regarding the plate as truly illustrative of the Swartzian species — apparenty on the strength of its citation by Swartz — faithfully describes the Jamaican plants agreeing with the plate under the name *myosuroides.* The true *myosuroides* he describes under the Hookerian name *Jamesoni.*

We propose to restore the name *myosuroides* to the plants characterized by Swartz in the *Prodromus.* Schkuhr's plant has to this day never received a valid name.

The facts in the case, which are self-evident, were brought to our attention by the manifest inappropriateness of Jenman's application of the peculiarly descriptive term *myosuroides* — "mouse-tail-like," with obvious allusion to the "mouse-tail" apex or *cauda* — to plants not possessed of any such characteristic prolongation, *i. e.*, the plant figured by Schkuhr.

The synonymy will stand as follows:

POLYPODIUM MYOSUROIDES Sw. Prodr. 131. 1788.

Grammitis myosuroides Sw. Schrad. Jour. Bot. **1800**[2]: 18. 1801.

Polypodium myosuroides Sw. Fl. Ind. Occ. **3**: 1644. 1806, in greater part.

Grammitis myosuroides Sw. Syn. Fil. 22. 1806, in part, excluding reference to Schkuhr's plate.

Xiphopteris myosuroides Kaulf. Enum. Fil. 85, 300. 1824.

Xiphopteris Jamesoni Hook. Second Cent. Ferns *pl. 14.* 1861.

Polypodium serrulatum β strictissimum Hook. Sp. Fil. **4**: 175. 1862.

Polypodium Jamesoni Jenman, Bull. Bot. Dept. Jamaica II. **4**: 112. 1897.

JAMAICA; BRITISH GUIANA; VENEZUELA; ECUADOR.

Jenman's description of this species under the name *Polypodium Jamesoni* is in all respects a true one, based upon the common and typical Jamaican plants.

Polypodium delitescens nom. nov.

Grammitis myosuroides Schkuhr, Krypt. Gewächse, **1**: 9. *pl. 7.* 1804; not Sw. 1801.

Polypodium myosuroides Jenman, Bull. Bot. Dept. Jamaica II. **4**: 112. 1897; not Sw. 1788.

Apparently confined to Jamaica.

The species is well characterized by Jenman under the name *Polypodium myosuroides.* It is to be distinguished from the true *myosuroides*: (1) commonly by its pinnatifid condition throughout, though less deeply lobed in the upper (fertile) portion than below; (2) by its distinct sori, these never entirely confluent with age, a character consequent upon its pinnatifid condition; (3) by its *approximate* nearly deltoid lobes, these never remote or subspatulate as in *myosuroides;* and by numerous less obvious characters as determined from a large series of specimens obtained in Jamaica by Mr. Jenman, Professor Underwood and the writer.

Schkuhr's original plant, if existent, will stand as the type; otherwise the type will be sheet *no. 427770*, in the U. S. National Herbarium, collected at the Summit of Blue Mountain Peak, altitude about 2220 meters, *Maxon 1513*, April 20, 21, 1903. *Underwood 2579*, in the herbarium of the New York Botanical Garden, has identical data.

The following note, which is without reference to the foregoing, has to do merely with the untenable name *saxicolum* given by Baker to a Jamaican high-mountain ally of *Polypodium moniliforme.* The plant occurs entangled with great mats of liverworts and mosses which closely envelope not only rocks but tree-trunks in the higher forested slopes of the Blue Mountains. Its characteristic growth has suggested the following name:

Polypodium induens nom. nov.

Polypodium saxicolum Baker, Jour. Bot. Brit. & For. **15**: 264. 1877. Not *Polypodium saxicola* Sw. Vet. Akad. Handl. Stock. **1817**: 59. 1817.

The specimens in the U. S. National Herbarium are:

JAMAICA. — A sheet without definite locality (ex herb. Botanical Dept. Jamaica). Near Morce's Gap, altitude 1500 meters; *Maxon 1214* and *2770.* Highest slopes of John Crow Peak, altitude 1650–1800 meters; *Maxon 1324* and *1332.*

U. S. NATIONAL MUSEUM.

New species of fungi

Charles Horton Peck

Lepiota maculans

Pileus thin, convex, subumbonate, dry, minutely and densely squamulose, reddish-yellow, the center darker; lamellae broad, subdistant, free, white, gradually changing to red or pink; stem equal, tough, floccose or fibrillose, hollow, whitish or yellowish, the annulus slight, evanescent; spores elliptic, uninucleate, pointed at the ends, variable in length, 8–12 μ long, 5–6 μ broad.

Pileus 1.5–2 cm. broad; stem about 5 cm. long, 2–3 mm. thick.

St. Louis, Mo. September. N. M. Glatfelter.

This is a small but pretty species, easily known by the flesh of both pileus and stem changing to a reddish color where wounded and by the lamellae assuming a reddish or pink color with age or in drying.

Mycena denticulata

Pileus thin, subcampanulate or convex, obtuse, glabrous, gray tinged with brown, the cuticle separable; lamellae rather broad, subdistant, ventricose, decurrent with a tooth, pale-brown, purplish on the edge, usually denticulate; stem slender, equal, straight, hollow, glabrous, whitish or yellow; spores elliptic, 7–8 μ long, 4–5 μ broad.

Pileus 12–20 mm. broad; stem 5–7 cm. long, 1–2 mm. thick.

St. Louis, Mo. August. N. M. Glatfelter.

Pleurotus umbonatus

Pileus fleshy, convex, umbonate, fibrillose, subsquamulose, brown or blackish-brown, flesh white, the cuticle sometimes rimose; lamellae broad, subdistant, adnate or slightly decurrent, brownish when dry; stem eccentric, equal or tapering downward, stuffed or hollow, colored like or a little paler than the pileus; spores white, subglobose or broadly elliptic, 5–6 μ long, 4–5 μ broad.

Pileus 2–7 cm. broad; stem 2–4 cm. long, 0.5–1 cm. thick.

Ground. Kittanning, Pa. October. D. R. Sumstine.

Lactarius Sumstinei

Pileus rather thin, dry, glabrous, even or slightly and radiately rugulose, centrally depressed, the margin spreading or decurved, grayish or pale smoky-brown, flesh whitish, milk whitish, unchangeable, taste acrid; lamellae thin, distant, unequal, decurrent, creamy-yellow; stem nearly equal, glabrous, stuffed or hollow, colored like the pileus; spores globose, echinulate, yellowish, 7.5–10 μ broad.

Pileus 2.5–7.5 cm. broad; stem 2.5–5 cm. long, 6–12 mm. thick.

Grassy places in open woods. Kittanning, Pa. August. D. R. Sumstine. Related to such species as *Lactarius fuliginosus*, *L. Gerardii* and *L. lignyotus*. It may be separated from the first by its unchangeable milk and its more distant lamellae and from the others by its acrid taste.

Marasmius Sutliffae

Pileus thin, tough, subcampanulate or convex, glabrous, shining when moist, reddish-brown, often darker in the center, taste bitter; lamellae broad, moderately close, subventricose, adnexed, white, often with a slight pinkish tint, interspaces venose; stem slender, cartilaginous, hollow, glabrous or slightly pruinose, pallid, with a whitish tomentum at the base; spores white, elliptic, 8–10 μ long, 5–6 μ broad, often containing a shining nucleus.

Pileus 1–2 cm. broad; stem 2.5–4 cm. long, 2–3 mm. thick.

On lawns in shaded places. Sacramento, California. October and November. Miss M. L. Sutliff.

I take pleasure in dedicating this interesting species to its discoverer. She writes that in her trial of its edible qualities she found that cooking seemed to intensify its bitter flavor and make it rival that of quinine.

Panus meruliiceps

Pileus tough, firm, compact, convex, glabrous, reticulated with elevated anastomosing ridges, involute on the margin, pale brick-red becoming tinged with yellow in the center, flesh white, 1–1.5 cm. thick; lamellae narrow, close, adnate or slightly decurrent with a tooth, slightly connected at the base, whitish; stem eccentric, curved, solid, fibrous, glabrous, grooved, white; spores subglobose or broadly elliptic, pinkish-tinged, 7 μ long, 6 μ broad.

Pileus 2.5–4 cm. broad; stem 2.5–4 cm. long, 8–12 mm. thick.

Trunks of elm trees. St. Louis, Mo. N. M. Glatfelter.

This is a very rare and peculiar species of which only five specimens have yet been found. One was found in April and one in May, 1898, one in May, 1902, and two in July, 1903. The specimen sent for identification was still flexible when received in March, 1904, showing that the mushroom dries with extreme slowness and does not readily become hard and brittle.

Flammula multifolia

Pileus convex, subumbonate, glabrous or obscurely fibrillose, tawny-yellow, sometimes paler on the margin and darker in the center, the margin incurved, flesh faintly tinged with yellow; lamellae narrow, numerous, crowded, rounded behind, adnexed, colored like or a little paler than the pileus, the edges crenulate with yellow or reddish-yellow glandular drops; stem equal or slightly thickened at the base, solid, floccose, fibrillose or subglabrous, yellow, sometimes eccentric; spores subglobose, 4–5 μ broad.

Pileus 5–8 cm. broad; stem 2.5–3.5 cm. long, 2–5 mm. thick.

Decaying wood in ravines. St. Louis, Mo. N. M. Glatfelter.

Cortinarius Braendlei

Pileus fleshy, firm, convex with incurved margin, silky, brownish-lilac, often varied by yellowish-brown stains, the young margin covered by the grayish-white silky veil, flesh lilac, specially in the young plant, odor like that of radishes; lamellae narrow, close, slightly rounded behind, adnate, eroded on the edge, grayish tinged with lilac; stem stout, solid, silky-fibrillose, bulbous, white or whitish; spores oblong-elliptic, obscurely granular, 12–15 μ long, 7–8 μ broad.

Pileus 7–12 cm. broad; stem 5–7 cm. long, 10–15 mm. thick.

Among fallen leaves in woods. Washington, D. C. October. F. J. Braendle.

Sometimes the pileus loses all its lilac color and becomes wholly yellowish-brown. The bulb of the stem is often pointed below. The species belongs to the section *Inoloma*.

Cortinarius Morrisii

Pileus fleshy except on the thin and at length reflexed margin, convex, irregular, hygrophanous, ochraceous or tawny-ochraceous, flesh thin, colored like the pileus, odor weak, like that of radishes; lamellae broad, subdistant, eroded or uneven on the edge, rounded behind, adnexed, pale-yellow when young, becoming darker with age; stem nearly equal, fibrillose, solid, whitish or pale-yellow and silky at the top, colored like the pileus below and fibrillose, irregularly striate and subreticulate, the double veil whitish or yellowish-white and sometimes forming an imperfect annulus; spores tawny-ochraceous, subglobose or broadly elliptic, uninucleate, 8–10 μ long, 6–7 μ broad.

Pileus 3–10 cm. broad; stem 7–10 cm. long, 1–2 cm. thick.

Moist shaded places under hemlock trees. Ellis, Mass. August to October. G. E. Morris. The species belongs to the section *Telamonia*.

Stropharia Schraderi

Pileus fleshy, firm, convex becoming nearly plane, dry, fibrillose, squamose or rimose-squamose in the center, pallid when young, becoming tinged with ochraceous-buff when mature, flesh white, taste like that of radishes; lamellae thin, close, adnate, whitish becoming brown; stem short, solid, subequal, white and sprinkled with mealy particles above the annulus, colored like the pileus and squamose below, annulus small, lacerated, white and sometimes evanescent; spores elliptic, 7–8 μ long, 4–5 μ broad.

Pileus 5–8 cm. broad; stems 2–3 cm. long, 8–12 mm. thick.

Sandy grassy soil about stumps. Washington, D. C. October. F. F. Schrader.

Psathyra multipedata

Pileus submembranaceous, conic or hemispheric, glabrous, hygrophanous, light-bay or tawny when moist, cinereous when the moisture has escaped, the center retaining its moisture longer than the margin; lamellae thin, close, adnate, pallid or gray becoming brown, whitish on the edge; stem slender, equal, hollow, brittle, furfuraceous, becoming smooth or sometimes remaining fibrillose near the base, pure white; spores brown, elliptic, 6–8 μ long, 4–5 μ broad.

Pileus 12–16 mm. broad; stem 5–10 cm. long, 2 mm. thick.

Densely cespitose, forming tufts of many individuals. Grassy ground. St. Louis, Mo. September and October. N. M. Glatfelter.

This is related to *P. bifrons* and *P. semivestita*. From the former it may be separated by the absence of red or pink tints from the pileus and from the latter by its smaller size and smaller spores.

Geopyxis nebulosoides

Receptacle cupular, stipitate, 2–6 mm. broad, pale-gray, externally pruinose or minutely mealy, the margin usually incurved;

hymenium pale-gray; stem equal to or slightly exceeding the diameter of the receptacle, even or sulcate, pruinose; asci cylindric, 200 μ long, 12 μ broad; spores oblong-fusiform, blunt or pointed at the ends, even, 25–40 μ long, 7–8 μ broad, containing 1–6 shining oil-globules; paraphyses filiform, often a little longer than the asci.

Decorticated wood. Canada. J. Macoun.

The species is closely related to *G. nebulosa* Cooke, from which it may be distinguished by its longer somewhat sulcate stem, its pruinose exterior and its smooth nucleated spores.

The Polyporaceae of North America — X. Agaricus, Lenzites, Cerrena, and Favolus

William Alphonso Murrill

Plants with variable daedaleoid or lamelloid hymenium and light-colored context and spores form the subject of the present article. These plants, like those of the genus *Sesia* discussed in article IX, recognize none of the ordinary specific or even generic limitations of the group and must be treated in a class by themselves. If they were amenable to ordinary methods of cultivation, they would surpass *Oenothera* in supplying most excellent examples of mutation.

Through the genus *Favolus*, taken up at the close of this paper, we return to the normal poroid forms of the family.

AGARICUS (Dill.) L. Sp. Pl. 1176. 1753

Striglia Adans. Fam. Pl. **2**: 10. 1763.
Daedalea Pers. Syn. Fung. 499. 1801.
Daedaleopsis Schroet. Krypt. Fl. Schles. **3**: 492. 1888.

The type of the genus *Agaricus* is *Agaricus quercinus* L. This is the only species common to Linnaeus and Dillenius, the author of the genus. Primarily, the name *Agaricus* was applied to dimidiate woody forms and the application of the present code* restores it to one division of this group. It is unfortunate that the association of fleshy and woody forms by Linnaeus under the name *Agaricus* has entirely diverted it from its earlier use and made necessary a number of changes in its restoration. Such changes could be avoided in only one way, *i. e.*, by applying canon 15 (f) of the code, which allows a well-known economic species to be selected as the type in order to avoid change in the current application of a Linnaean generic name. *Agaricus campestris* is such a species and *might* be adopted as the type of the genus *Agaricus.* I hesitate, however, to make use of a provision designed especially for *Poa pratensis.* I fear also that this provision, being the only one

* Bull. Torrey Club, **31**: 249–261. 1904.

of its kind in the code, is in danger of being overworked. Moreover, I have good reason to know that a mere makeshift of this kind will never be accepted by working mycologists as permanent. *Agaricus*, then, properly figures as a genus of the *Polyporaceae.*

The genus *Striglia* was founded by Adanson upon Batarra's *plate 38*, which represents several common species of *Agaricus*, the first being *A. quercinus* L.

Daedalea of Persoon was founded on *D. quercina* (L.) and four other species, one of them being *D. confragosa.* Batarra is quoted at some length and *plate 38* cited by Persoon, but no mention is made of *Striglia*, based on the same plate.

Daedaleopsis, founded upon the single species *Daedalea confragosa* (Bolt.), completes the list of synonyms.

Species belonging to the genus *Agaricus* have white or wood-colored context, hyaline spores and poroid, daedaleoid or lamelloid tubes. One rare species, *A. juniperinus*, occurs on coniferous wood; all the others are found abundantly on decaying wood of various deciduous trees. One species, *A. deplanatus*, is tropical; the rest occur in the United States and Canada, and two of these are found also in Europe. Most of the species, in spite of the remarkable variability of some of them, are easily distinguished; *A. Aesculi* and *A. deplanatus*, however, approach very near each other in some of their forms.

Synopsis of the North American species

1. Tubes one to several millimeters in transverse diameter; surface usually brown or discolored; plants found in temperate regions. 2.
   Tubes less than one-half millimeter in transverse diameter; surface white or yellowish; plants found in the southern states or the tropics. 3.

2. Pileus thick, triangular, margin obtuse; tubes large, daedaleoid, dissepiments obtuse; context wood-colored; plants abundant on oak. 1. *A. quercinus.*
   Pileus thick, triangular, margin obtuse; tubes large, daedaleoid, dissepiments obtuse; context white; plants rare on red cedar. 2. *A. juniperinus.*
   Pileus thin, applanate, multizonate, margin very acute; hymenium poroid, daedaleoid or lamelloid, dissepiments acute. 3. *A. confragosus.*

3. Pileus reniform, rigid, usually azonate; plants found in the southern states. 4. *A. Aesculi.*
   Pileus thin, flexible, variously shaped, usually multizonate; plants confined to the tropics. 5. *A. deplanatus.*

1. AGARICUS QUERCINUS L.

Agaricus quercinus L. Sp. Pl. 1176. 1753.—Sow. Engl. Fung. *pl. 181.*

Agaricus labyrinthiformis Bull. Herb. Fr. *pl. 352.* 1787.

Daedalea quercina Pers. Syn. 500. 1801.

Polyporus latissimus Fr. Obs. **1**: 128. 1815.

Daedalea quercina var. *nigricans* Fr. Syst. **1**: 333. 1821.

This very common species has been known from ancient times on account of its size and abundance and because it grows on stumps and timbers in conspicuous places. The abundant use of oak, its favorite host, brings it to the attention of many. Bauhin and other prelinnaean botanists seem to have been impressed with the striking appearance of its hymenium, expressed by Linnaeus in his "Agaricus acaulis, lamellis labyrinthiformibus" and by Bulliard in his choice of a specific name. The figure on Batarra's plate 38 is a rather old blackened form of this species, distinguished by him as a variety and cited by Fries as var. *nigricans*. *Polyporus latissimus* was described by Fries from resupinate forms frequent on structural oak timbers before he was well acquainted with the variations of the species. As this species is so extremely common and well-known, it is not considered necessary to give a list of available collections. All the exsiccati contain specimens of it, and one can hardly fail to find it at any season of the year on some oak stump or decaying trunk.

2. **Agaricus juniperinus** sp. nov.

Sporophore corky, sessile, attached by a broad, often decurrent, base, composed of imbricate, terraced or laterally connate, ungulate pilei 2–5 × 2–7 × 1.5–3 cm.; surface irregular, anoderm, finely tomentose, yellowish-white, becoming cinereous with age; marginal edge fertile, concolorous, not rounded, but often forming an obtuse angle: context corky, white, concentrically banded, 0.5–1 cm. thick; furrows large, labyrinthiform, radially, rarely otherwise, elongated, 0.5–2 cm. long, 1–3 mm. wide, white or pallid, edges obtuse, often splitting into broad irpiciform plates: spores smooth, hyaline, ovoid, 3–4 × 5–6 μ.

The type plants of this species were collected by Bartholomew on a red cedar stump near Rockport, Kansas, November 8, 1894. It was again collected by Bartholomew on the same host but in a different locality in 1896, and Demetrio found it in Cole County, Missouri, September, 1898, growing in a decayed spot on a living red cedar trunk.

The nearest American congener of this species is probably *A. quercinus*, from which it may be easily distinguished by its milk-white context. It is also known only on red cedar, while *A. quercinus* occurs on the wood of deciduous trees.

3. **Agaricus confragosus** (Bolt.)

Boletus confragosus Bolt. Halifax Fung. Suppl. **3**: 160. *pl. 160.* 1791.
Daedalea confragosa Pers. Syn. 501. 1801.
Daedalea rubescens Alb. & Schw. Consp. Fung. 238. *pl. 11. f. 2.* 1805.
Daedalea albida Schw. Syn. Car. 67. 1818. Fr. Not *D. albida.*
Daedalea zonata Schw. Syn. Car. 68. 1818.
Daedalea discolor Fr. Elench. Fung. 68. 1828.
Daedalea discolor Kl. Linnaea **8**: 481. 1833.
Daedalea corrugata Kl. Linnaea **8**: 481. 1833.
Trametes rubescens Fr. Epicr. 492. 1836.
Lenzites Klotzschii Berk. Ann. Mag. Nat. Hist. **7**: 452. 1841.
Lenzites Crataegi Berk. Lond. Jour. Bot. **6**: 323. 1847.
Lenzites unguliformis B. & C. Hook. Jour. Bot. **1**: 101. 1849.
Lenzites bicolor Fr. Nov. Symb. 43. 1851.
Lenzites Cookeii Berk. Grevillea **4**: 161. 1876.
Lenzites proxima Berk. Grevillea **4**: 162. 1876.

This remarkable species has a literary history in keeping with its wonderful variation in nature. Bolton appears to have the credit of noticing it first, and, fortunately, his description and figures are excellent. He speaks of it as growing on stumps and the dead roots of trees at Fixby-Hall, the type locality, and other places in Halifax. His description is here given:

"Boletus coriaceo lignosus sessilis dimidiatis, supra scabroso zonatus subfuscus, carne ferrugineo-pallide, tubis cinereis poris multiformis."

Persoon made use of Bolton's name, but does not seem to be clear as to the identity of the plant in question. Albertini and Schweinitz described it under the name of *D. rubescens*, at the same time questioning whether it might not be the same as *D. angustata* (Sow.) Fr. Schweinitz again described the thin forms met with in Carolina under different names, which were much discussed by European mycologists.

Fries changes one of Schweinitz's specific names to *D. discolor* in his Elenchus, because it was preoccupied by one of his own. Type plants of this species grew on birch trunks. A little later, Klotsch finds a specimen in Hooker's herbarium collected by Dr. Richardson on a birch trunk in boreal North America, which he determines as *D. discolor* Fr., but Fries disclaims it and calls it *D. discolor* "Kl. *nec* Fr." Then Berkeley throws the species into *Lenzites* and names it after Klotsch. This is only the beginning of Berkeley's career in connection with *D. confragosa*, for we find him between this time and 1876 assigning four new names to different specimens of this species, *L. Crataegi* to plants collected in Ohio by Lea, *L. unguliformis* to specimens sent from North Carolina by Curtis, *L. Cookeii* to Peck's specimens collected on willow and birch in New York and *L. proxima* to New York plants collected by Sartwell. *L. Lyallii* Berk. from Vancouver also seems to be a form of this species, but the type plants are in such poor condition that it is impossible to determine this with certainty.

A form found in Mexico by Schiede and recently duplicated by Smith appears to have as much claim to distinction as any yet reported, if it were only possible to separate it from thin lenzitoid forms found in the Southeastern states. In describing this form in 1851, as *L. bicolor*, Fries says that he had received the same thing from Curtis in South Carolina under the name of *D. tricolor*. A full discussion of this and several other varieties, by Peck, may be found in the 30th Report of the N. Y. State Museum of Natural History; on page 73 the author summarizes the forms discussed which have received specific names as follows:

"*Daedalea confragosa* Pers. which is represented by forms of our plant having a scabrous somewhat zoned pileus of a reddish-brown color and a daedaleoid hymenium."

"*Trametes rubescens* A. & S. which is represented by forms that assume the ruddy color and have the trametoid hymenium."

"*Lenzites Crataegi* Berk. which is represented by forms having a shining pileus attached by the vertex and having a trameto-lenzitoid hymenium."

"*Lenzites Cookei* Berk. which is represented by forms with the pileus of a cervine hue and with a trameto-lenzitoid hymenium."

"*Lenzites proxima* Berk. with the thin flattened pileus completely overspread by the peculiar tomentum previously described."

Peck considers all these varieties of one protean species and suggests that the specific names under which they were described be retained as varietal names.

After the study of a quantity of material, including most of the original type collections, and numerous observations of various stages of this plant in the field, I am forced to confess that in spite of its wonderful variation in size as well as in general appearance, I find it impossible to make more than one species of it. When the ordinary form common in New York is compared with specimens from the Carolinas only 1 cm. in diameter and they in turn with large, thick poroid forms from Florida or very thin, expansive lenzitoid forms from Mexico, one at once concludes that he is dealing with different plants; but let a large array of specimens from different localities be examined and all the specific distinctions seem to disappear in well-graded intermediate forms which are with difficulty set aside. It is not strange that the foreign mycologists who had only isolated specimens to deal with should have erected so many species.

In examining European forms, some are easily recognizable as distinct from those seen in America, but, knowing this plant as we do at home, who shall attempt to separate any of them specifically!

This species is met with abundantly about New York growing on dead trunks or branches of sweet gum, willow, birch, oak, dogwood, alder, beech and other deciduous trees and shrubs. The tubes are usually daedaleoid, sometimes porous, when young, very pale flesh-colored, turning at once to yellowish-brown when bruised. The surface is light to dark yellowish-brown and the margin, which is lighter, shows fan-like radiations of growth. Zones may or may not be present. As the fruit becomes older, the tubes very often become lenzitoid and various changes take place in the appearance of the surface. The spores are hyaline, cylindrical, $9 \times 2\ \mu$.

The following collections will indicate the wide range of the species in North America: Rav. Fung. Car. Fasc. 2. nos. *15* and

416; Ell. & Ev. N. A. Fung. *1924*, *1925*, *1926*, *1927*, *1928*; Underw. & Cook, Illus. Fung. *18*; Shear, N. Y. Fung. *40*; Canada, *Macoun*, *Dearness*; Maine, *Blake*, *Miss White*; Connecticut, *Seymour*, *Earle*, *Miss White*, *Underwood*; New York, *Barbour*, *Peck*, *Mrs. Britton*, *Underwood*, *Earle*, *Murrill*; New Jersey, *Martindale*, *Earle*, *Anderson*, *Murrill*; Delaware, *Commons*; Pennsylvania, *Stevenson*, *Sumstine*, *Gentry*; Maryland, *Miss Banning*, *Shear*, *Ricker*; Virginia, *Murrill*; North Carolina, *Memminger*; Georgia, *Harper 2037a*, *2042a*; Alabama, *Earle*, *Baker*; Louisiana, *Langlois*; Florida, *Calkins*; Ohio, *Morgan*; Tennessee, *Murrill 594*, *607*; Kansas, *Bartholomew*; Wisconsin, *Baker*; Texas, *Hodson*.

4. **Agaricus Aesculi** (Schw.)

Boletus Aesculi flavae Schw. Syn. Fung. Car. 70. 1818.

Polyporus Aesculi Fr. Elench. 99. 1818.

Trametes incana Berk. Lond. Jour. Bot. **4**: 305. 1845. Not *T. incana* Lév.

Daedalea ambigua Berk. Lond. Jour. Bot. **4**: 305. 1845.

Trametes ambigua Fr. Nov. Symb. 96. 1851.

Trametes lactea Fr. Nov. Symb. 96. 1851.

Lenzites glaberrima B. & C. Grevillea **1**: 34. 1872.

Daedalea glaberrima B. & C. Grevillea **1**: 67. 1872.

Trametes Berkeleyi Cooke in Sacc. Syll. Fung. **9**: 194. 1891.

The first description recorded of this species is that made by Schweinitz in his Synopsis under the name of *Boletus Aesculi flavae*, which is as follows:

"B. minor subimbricatus, pileo dimidiato duriusculo fornicato glabriusculo pallido margine sterili, poris minutis sulphureis."

"In arboribus, imprimis *Aesculi flavae* Wilkes County, ad ripam Yadhin. Caespites duas tresve uncias longi. Parum imbricatus, fere simplex. Pileus suberosus, subtenuis, basi crassior, glaber, tactu subtomentosus. Pori demum nigrescunt."

This is not a good description of the plant. Several statements in it are misleading as well as incomplete. It is possible that Schweinitz confused this species with one ordinarily known as *P. hemileucus*, rather common in the Carolinas. This supposition would account for Fries' remark with reference to the specimen sent him by Schweinitz that it was "*rubiginosus*." However, the plant in the Schweinitz herbarium is undoubtedly *Daedalea ambigua* and not *P. hemileucus*, which settles the question of type.

Trametes incana Berk. was founded on specimens collected by Lea on dead trunks of trees in Ohio. These specimens were possessed of a very short lateral, disciform stem, a yellowish hymenium and roundish, or rarely linear and sinuous, pores. The name was changed to *Trametes Berkeleyi* in 1891 by Cooke because of *Polyporus* (*Trametes*) *incana* Lév. (Bonite, Crypt. 183. 1844–1846), described from the Philippines. Although *Trametes* seems to be used here as a subgenus, the author writes it as a genus lower down on the same page when he comes to refer to and describe the figures: "*Pl. 137. f. 2. Trametes incana* de grandeur naturelle," etc.

Daedalea ambigua was described by Berkeley in almost the same breath with the previous species and the specimens were collected in the same locality by Lea. Montagne considered the two species the same, but Berkeley, influenced to a considerable extent by Lea, finally decided to make them distinct because of the narrow, sinuous pores of the latter.

Trametes lactea was described from plants sent to Fries from Carolina by Curtis. These plants were evidently porous forms of this species and naturally fell under the genus *Trametes* so far as Fries could determine from the material.

Lenzites glaberrima was also described from Carolina material sent by Curtis. This time the tubes were lenzitoid and anastomosing and there was an orbicular disc for the base.

Daedalea glaberrima was meant by Berkeley for an entirely distinct species. The pores are described as "at length sinuous" and the stem as "lateral, one-half an inch long and wide." The type specimens were sent from South Carolina by Curtis.

In addition to the above, several other names have been used quite freely by collectors and systematists in connection with this species. *Trametes marchionica*, for example, described from the Marquesas Islands by Montagne (Voy. Pole Sud, 204. 1845), is often treated as a synonym of *D. ambigua*. *Trametes Mülleri* Berk. is applied to Cuban forms of *D. ambigua* at Kew and elsewhere, although the type locality of the species is the Victoria

River, Australia. There is ample excuse for this, however, in the fact that this species is described in a work on Cuban fungi and is undoubtedly considered by the author to exist in Cuba; nevertheless, since no definite statement to this effect nor the citation of a collector's number accompanies the description, the type locality as given and also as implied in the personal specific name must be considered the correct one for the species. There exists a very close relationship between the various forms of *D. ambigua* and species described from regions of the Orient, but a discussion of this relationship is beyond the scope of the present article.

As one may judge from the above discussion, *Agaricus Aesculi* is a variable species and liable to confuse the collector who relies too much upon regularity of pore-structure. If one considers the variability of the genus, however, he will have little trouble in distinguishing it by color, surface and size. It is found on stumps, trunks, and other forms of decaying wood of oak, sycamore, etc., in the Southern states. Specimens are at hand from Missouri, *Demetrio;* Kansas, *Bartholomew;* Ohio, *Morgan, Lloyd;* South Carolina, *Ravenel;* Florida, *Martin, Rau, Calkins, Lloyd;* Texas, *Hodson 320*.

5. **Agaricus deplanatus** (Fr.)

Daedalea elegans Spreng. Vet. Acad. Handl. 51. 1820. — Fr. Syst. **1**: 335. 1821; Elench. 69. 1828. Not *Agaricus elegans* Scop. Fl. Carn. ed. 2. **2**: 438. 1772.

Daedalea deplanata Fr. Linnaea **5**: 513. 1830.

Lenzites deplanata Fr. Epicr. 404. 1838.

Trametes elegans Fr. Epicr. 492. 1838.

Trametes centralis Fr. Nov. Symb. 95. 1851.

The name *Daedalea elegans* was first assigned to plants found on tree trunks in Guadeloupe. Sprengel's original description is as follows:

"D. coriaceo-lignosa sessilis, pileo supra albido glaberrimo, subtus alutaceo, lamellis anastomosantibus in poros marginales abeuntibus."

This was enlarged by Fries after the study of a considerable variety of forms. Ten years later Fries himself described another form of the same species collected by Beyrich in Brazil under the name of *Daedalea deplanata*. His *Trametes centralis*, also a synonym, is based upon collections made in the West Indies, Costa Rica and Mexico, in which the sporophores are sessile at the center, with pores decurrent to the base.

Other species, either synonymous or closely related to those above described, but purposely kept separate at this time from North American forms are as follows:

Daedalea amanitoides Palis. de Beauv. Fl. Owar. **1**: 44. *pl. 25.* 1804. *Daedalea Palisoti* Fr. Syst. **1**: 335. 1821. *Lenzites Palisoti* Fr. Epicr. 404. 1838. Afzel. Fung. Guin. **1**: *pl. 11. f. 23. a, b.* The species was described from Oware, growing on trunks. I know of no reason for changing the specific name to *Palisoti.*

Daedalea repanda Pers. Freyc. Voy. 168. 1826. Mont. Cuba 382. *pl. 14. f. 4.* 1842. *Lenzites repanda* Fr. Epicr. 404. 1838. (Not *Agaricus repandus* Bull.) Described from the island of Rawak as "D. latissima albido-pallens, pileo glabro zonato margine repando, sinulis angustis densis, margine subdentatis." Montagne adopts the name for Cuban specimens and cites *D. polita, D. deplanata, D. laevis, D. applanata, D. Palisoti* and *D. indica* as synonyms. He appears to have given considerable attention to the various forms in Cuba with reference to growth and variation.

Daedalea polita Fr. Linnaea **5**: 514. 1830. *Lenzites polita* Fr. Epicr. 404. 1838. Described from specimens in the herbarium of Willdenow collected by Bory on Bourbon, or Reunion, Island. The type in Fries' herbarium has the exact contour of *A. Aesculi,* but is thinner. The surface is like that of *A. Aesculi,* but the pores are more like those of *A. deplanatus.*

Daedalea applanata Kl. Linnaea **8**: 481. 1833. *Lenzites applanta* Fr. Epicr. 404. 1838. Collected on trunks in the island of Mauritius by Telfair and described from the herbarium of Hooker. The author questions if it is not *D. deplanata* Fr. or *D. polita* Fr.

Polyporus (*Trametes*) *lactineus* Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 373. 1843. Described from specimens collected by Koenig in Ceylon and named by him in herbarium "*Boletus lacteus.*" Berkeley does not distinguish it from forms found in the West Indies.

Lenzites platypoda Lév. Bonite, Crypt. 184. 1844–1846. This appears to be in no way specifically distinct from *Daedalea repanda*

Pers., but the author, who was at that time but little acquainted with oriental forms, thinks that the stipe and pores sufficiently distinguish it from Persoon's species.

This exceedingly variable and very attractive species is abundant on decaying wood in tropical America. In some localities the young sporophores, although tough, are used as food by the natives. It differs from *A. Aesculi* in being thin and flexible and usually much more zonate, though at times the two species are not easily distinguished. One is here forcibly reminded of *Pycnoporus cinnabarinus* and *Pycnoporus sanguineus*, which exhibit much the same relations, indicating that the effect of tropical conditions may be to produce a thinner, more expanded and more zonate sporophore.

Specimens are at hand from Florida, *C. G. Lloyd*; Bahamas, *Mrs. Britton 773, 847*; Porto Rico, *Wilson 294*; Hayti, *Nash 234, 240*; Cuba, *Underwood & Earle 1522, Hamilton*; Mexico, *Egeling*; Nicaragua, *Smith*; British Guiana, *Millspaugh 13529*; Honduras, *Wilson 411*; Yucatan, *Millspaugh 57800*; Colombia, *Baker*.

SPECIES INQUIRENDAE

Daedalea subtomentosa Schw. Syn. Fung. Car. 68. 1818. Described from North Carolina material as follows:

"D. minor gibbosa, zonis elevatis subtomentosis albida, sinubus poriformibus angustis albis et pallidis. Passim. Species non valde distincta. Pileus glaber tuberculosus."

This is very probably another synonym of *A. confragosus*, but I have not been able to find type material. Even Schweinitz himself says that it is not a very distinct species.

Irpex maximus Mont. Ann. Sci. Nat. II. Bot. **8**: 364. 1837. Syll. Crypt. 174. 1856. *Polyporus labyrinthicus* Mont. Cuba, 406. 1842 (not *P. labyrinthicus* Fr. Elench. 83. 1828).

This species was described from material collected by Ramon de la Sagra on the trunks of trees in Cuba. Montagne's earlier description is as follows:

"Pileo coriaceo tenui reniformi plano-convexo velutino marginem versus repandum acutum concentrice sulcato demum basi glabrescenti subradiato dentibusque confertis acutis pubescentibus ochroleucis."

"Pileus 8 poll. transversim latus, 6 poll. longus, vix lineam semis cum dentibus crassus, subtus vel ad marginem prolifer. Eximie distincta species nec cum ulla alia confundenda."

Before the appearance of his work on Cuban cryptogams, Montagne seems to have changed his mind regarding the distinctness of this species and in that work adopts Fries' name and description for his plant.

Lenzites tenuis Lév. Ann. Sci. Nat. III. Bot. **5**: 122. 1846. Collected on trunks in Guadeloupe and thus described:

"Pileo subflabellato coriaceo azono nudo pallide ochroleuco postice fuscescente margine acutissimo lobato quandoque prolifero, lamellis rectis dichotomis anastomosantibus acie acutis concoloribus."

"Cette espèce est voisine du *Lenzites polita*, dont elle diffère par le peu d'épaisseur du chapeau et la ténuité des lames; la marge, qui est très mince, donne quelquefois naissance à d'autres petits chapeaux. Il atteint de 8 à 10 centimètres dans son plus grand diamètre."

This species resembles thin forms of *Agaricus confragosus*, but more material is needed to determine its exact relations.

Daedalea violacea Lév. Ann. Sci. Nat. III. Bot. **5**: 142. 1846. Described from specimens collected on trunks in Cuba as follows:

"Pileo coriaceo applanato semi-orbiculari nudo inaequabili zonato lurido e basi ad marginem patentem acutum lobulatum fibroso-radiato, sinubus minutissimis anastomosantibus violaceis."

"Chapeau coriace, large de 12 à 14 centimètres, épais de 5 millimètres, à surface zonée, nue, inégale, marquée de stries qui naissent de la base et s'étendent à la marge. Cette espèce de *Daedalea* rappelle par la ténuité des sinus ceux de l'*Hymenogramme javensis*, et présente sur les deux faces une couleur violette semblable à celle du *Polyporus Auberianus*. On ne peut cepandant confondre ce *Daedalea*, quoique du même pays, avec ce dernier, dont les pores sont ronds."

Daedalea plumbea Lév. Ann. Sci. Nat. III. Bot. **5**: 302. 1846. Described from plants collected on trunks in New York as follows:

"Pileo sessili reniformi vel semi-orbiculari coriaceo depresso zonato inaequabili nudo plumbeo, sinubus lamellosis labyrinthiformibus laxis obtusis fuscis, contextu concolori."

"Chapeau coriace, semi-orbiculaire ou réniforme, large quelquefois de 2 décimètres : sa marge tend constamment à se relever. La surface est nue, tuberculeuse,d'un gris plombé; les sinus sont àpeu près semblables à ceux du *Daedalea quercina*, mais d'une couleur obscure, ainsi que le parenchyme du chapeau."

The above description indicates that the author was possibly dealing with old and darkened specimens of *Agaricus quercinus*.

Daedalea puberula B. & C. Grevillea **1**: 67. 1872. Described from plants collected in Pennsylvania by Michener as follows:

"Pileo molli-suberoso, irregulari, dimidiato, hic illic tuberculoso, puberulo, ochraceo; margine tenui: poris parvis demum sinuatis."

"About 4 inches across; irregular, corky, of a soft substance, which is slightly zoned, attached behind, and more or less decurrent, even, with the exception of a few obtuse, tubercular, elevations, finely pubescent; ochraceous; pores about 1/50 inch across, sinuated; of the same colour as the pileus."

LENZITES Fr. Gen. Hymen. 10. 1836

This genus, dedicated to Lenz, was described by Fries as follows:

"Lamellae coriaceae, radiantes, nunc simplices, nunc poroso-anastomosantes, acie compaginatae; dissepimento pileo floccoso."

Fries lists only three species, *L. betulina*, *L. abietina* and *L. heteromorpha*, the first of which we consider the type. As at present limited, the genus contains only two North American species, one very abundant in the United States and Canada and the other known only from Cuba.

Synopsis of the North American species

Surface of the pileus conspicuously tomentose.	1. *L. betulina*.
Surface of the pileus finely pubescent.	2. *L. cubensis*.

1. LENZITES BETULINA (L.) Fr.

Agaricus betulinus L. Sp. Pl. 1176. 1753.—Sowerby, Eng. Fung. *pl. 182*. 1799.

Daedalea betulina Rebentisch, Prodr. Fl. Neom. 371. 1804.—Fr. Obs. **1**: 104. 1815.

Lenzites betulina Fr. Gen. Hymen. 10. 1836.

Linnaeus describes this species as "Agaricus acaulis coriaceus villosus: margine obtuso, lamellis ramosis anastomosantibus." "Fl. Suec. 1085. Habitat in Betulis." Later botanists also described it under various other names. The plant is exceedingly common and is so well known as to need no description, being found in abundance on old stumps, fallen branches and other forms of deciduous wood throughout the north temperate zone. Fries says in his Epicrisis that it is confined to deciduous wood, but Peck states that it occurs also on that of evergreen trees. I have never seen it growing upon coniferous wood, but many of our fungi that normally occur upon deciduous wood have been known to attack that of dead conifers in the vicinity, or, in barren regions, when hard pressed for food.

The following specimens are listed in order to give some idea of the range of this species: Finland, *Karsten;* Germany, *Sydow;* Massachusetts, *Porter;* New York, *Britton, Murrill;* New Jersey, *Ellis, Mrs. Lobenstine;* Pennsylvania, *Barbour;* Virginia, *Murrill;* Tennessee, *Murrill 636;* South Carolina, *Ravenel;* Alabama, *Earle & Baker;* Missouri, *Demetrio;* Kansas, *Bartholomew;* Michigan, *Hicks;* Wisconsin, *Baker;* Montana, *Mrs. Fitch.* Many other collections and most of the published exsiccati contain good examples of this fungus.

2. LENZITES CUBENSIS B. & C.

Lenzites cubensis B. & C. Jour. Linn. Soc. Bot. **10**: 303. 1868.

Described from plants collected by Wright in Cuba on dead wood as follows:

"Pileo duro ligneo dimidiato subvelutino cervino zonato rugoso; stipite nullo vel brevissimo; lamellis repetite furcatis crenatis vel crispis concoloribus latioribus."

"Pileus 2½ inches broad and 1½ inches long."

Nothing is known of this species beyond the above description and a few type specimens still to be seen at Kew and Paris. It appears, however, to belong with our common species, *L. betulina,* from which it may at once be distinguished by its almost glabrous surface. It is no doubt rare and possibly confined to the higher altitudes of Cuba.

SPECIES INQUIRENDAE

Lenzites Berkeleyi Lév. Ann. Sci. Nat. III. Bot. **5**: 122. 1846. Based upon plants collected by Ménand in New York. *Daedalea betulina velutina* Berk. (Ann. Mag. Nat. Hist. **3**: 381. 1839) is cited as a synonym and doubtless accounts for the specific name adopted. Berkeley's description is as follows:

"Pileus hard, sessile, dimidiate, lobed, deeply zoned, tawny, velvety. Gills rather thick."

"New Orleans and other parts of North America. Hooker Herbarium. The pileus is by no means tomentose, but clothed with very short close velvety pubescence. Vertex sometimes lengthened out into a sort of stem. *Thelephora lobata* varies in the same way."

Léveillé's description of the species is as follows:

"Pileo coriaceo flexili subreniformi sessili hirsuto fulvo zonis confertis prominentibus notato, lamellis latissimis distantibus acie integris ochroleucis."

"Chapeau presque réniforme, coriace, large de 4 à 8 centimètres, d'une belle couleur fauve, avec des zones saillantes et assez rapprochées; les lames sont très larges, comparées à l'épaisseur du chapeau, jaunes, à marge tranchante et entière."

In their Commentary on Schweinitz' Synopsis, Berkeley and Curtis determine no. 486, "*D. an gibbosa*, ?" as *Lenzites Berkeleyi* Lév.

CERRENA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 649. 1821

This genus was founded upon *Cerrena cinerea* (Pers.), a single species. The very brief generic description, "Stem distinct: cap semicircular," is followed by the citation of two synonyms and a short description of the species. Although the descriptions are unsatisfactory, the citations point very plainly to a definite and well-known species as the type of the genus.

CERRENA UNICOLOR (Bull.) Murrill

Boletus unicolor Bull. Herb. France, *pl. 408.* 1788. *pl. 501.* 1791. — Bolt. Hist. Fung. Halifax, Append. 163. *pl. 163.* 1791. — Sowerby, Eng. Fung. *pl. 325.* 1801.

Boletus decipiens Schrad. Spic. 169. 1794.

Sistotrema cinereum Pers. Syn. 551. 1801.

Daedalea unicolor Fr. Syst. **1**: 336. 1821.

Phyllodontia Magnusii Karst. Hedw. **22**: 163. 1883.

Cerrena unicolor Murrill, Jour. Myc. **9**: 91. 1903.

This species was first described from France by Bulliard. The ordinary form has been known for a long time, but European mycologists were considerably puzzled in 1876 by the discovery of a peculiar hydnoid form on a birch stick in the fern house at

Berlin. Specimens were sent to various mycologists and one of them was described by Karsten as *Phyllodontia Magnusii*, in honor of the discoverer, and became the type of a new genus. Hennings later found specimens of the same form in the same place, and traced their connection with *Daedalea unicolor*.

Cerrena unicolor is extremely abundant on stumps, logs and various other forms of decaying deciduous wood in the north temperate zone. New pilei form early in the season from the old ones, the surface being at first light yellowish-white and very hairy, becoming gray with age. The tubes are porous in very young stages, but soon unite into complicated labyrinthiform channels and later split up into teeth resembling those found in the *Hydnaceae*. No choice beyond deciduous wood is apparent as regards host; oak, beech, poplar, walnut, hickory, birch, elm, apple and various other broad-leaved trees serving as food when dead or decayed.

Specimens have been examined in all the published exsiccati that pretend to exhibit northern plants of this group. From the following list a good idea may be gained of the wide range of the species: Russia, *Jaczewski;* Sweden, *Romell;* Germany, *Magnus;* Austria, *Bresadola;* France, *Patouillard;* Newfoundland, *Waghorne;* Maine, *Ellis*; New Hampshire, *Gerard, Blake, Jeffries;* Massachusetts, *Miss Minns;* New York, *Shear, Ellis, Underwood, Earle, Peck, Murrill;* New Jersey, *Ellis, Underwood, Earle, Murrill;* Pennsylvania, *Herbst, Stevenson, Small, Banker;* Delaware, *Commons;* West Virginia, *Nuttall;* Virginia, *Murrill 252;* Ohio, *Morgan, Lloyd;* Illinois, *Mrs. Roy;* Missouri, *Demetrio;* Kansas, *Cragin;* Michigan, *Pieters, Wood;* Iowa, *Holway.*

SPECIES INQUIRENDAE

Daedalea tortuosa Cragin, Bull. Washburn Lab. Nat. Hist. 1: 26. 1884. Jour. Myc. 1: 28. 1885. Described from specimens collected on rotten logs at Topeka, Kansas, as follows: "Pilei dimidiate, convex, often imbricated and confluent, between corky and woody, strigose-roughened, pale yellowish-brown, becoming smoother and paler, internally concolorous, zonate, one-twelfth to one-eighth of an inch thick, usually once or twice sulcate near the acute, minutely repand, ferruginous-brown margin.

(Margin sometimes concolorous.) Hymenium pale cinnamon-brown, generally effused at the base and abruptly sub-porous at the margin. Sinuses labyrinthiform, flexuose, intricate, torn and toothed; very similar to those of *D. unicolor* Fr., except in color and much larger size. The largest single pilei observed measure about two inches in length by three in breadth."

Authentic specimens of this plant have not been seen, but there appears to be little in the description to distinguish it from forms of *Cerrena unicolor*.

FAVOLUS Beauv. Fl. Owar. **1**: 1. *pl. 1.* 1805.

This genus was founded upon a single species, *F. hirtus* Beauv., which, although commonly known under the name of *Hexagona hirta*, recalls the true honeycomb-like structure of the hymenium which was originally the distinguishing feâture of the genus *Favolus*. The genera *Hexagona* and *Favolus*, both monotypic in origin, were interchanged by Fries because the species were unfamiliar to him and they have been incorrectly used ever since.

In the *Systema*, Fries followed Beauvois and included *Hexagona* under the subgenus *Favolus* of *Polyporus*. In the *Epicrisis*, Fries includes *F. hirtus*, Beauvois' type, in the genus *Hexagona* and follows it with *H. Mori*, Pollini's type. He then begins his genus *Favolus* with *F. europaeus*, a synonym of *H. Mori*.

The plants of this genus are not well known, few as they are. The two species ordinarily collected in North America are confined to the tropics, a comparatively unworked region. There is little difference either in the abundance or the distribution of these species, but they may be easily distinguished by color and markings. Both species vary rather remarkably in the size of their pores. Berkeley frequently commented upon it in his writings and his varieties testify to the fact. There appears to be absolutely no other different character accompanying this difference in pore measurement. A large collection of specimens is needed in order to guess at the cause of this variation, which at times amounts to two or three diameters.

Synopsis of the North American species

Surface marked with white and light-brown zones. 1. *F. tenuis.*

Surface variegated with dark-brown and purple zones. 2. *F. variegata.*

1. **Favolus tenuis** (Hook.)

Boletus reticulatus Hook. in Kunth, Synopsis **1**: (9). 1822. Not *B. reticulatus* Schaeff.

Boletus tenuis Hook. in Kunth, Synopsis **1**: (10). 1822.

Polyporus polygrammus Mont. Ann. Sci. Nat. II. Bot. **8**: 365. 1837.

Hexagona tenuis Fr. Epicr. 498. 1838.

Hexagona polygramma Fr. Epicr. 497. 1838.—Mont. Pl. Cell. Cuba 379. *pl. 14. f. 3.* 1842.

Hexagona favoloides Peck, Bull. Torrey Club **10**: 73. 1883.

This species is found in the Linnaean herbarium marked *Boletus favus*, but not by Linnaeus nor with his sanction. It was first described by Hooker from plants collected in the Andes between Popayan and Almaguer by Humboldt, under the name of *Boletus reticulatus*. Following this species on the next page is *Boletus tenuis*, described as differing from the preceding in its paler, smooth, dimidiate pileus and empty pores. According to Klotzsch, *Boletus reticulatus* is only a monstrous form of *Boletus tenuis* with the pores spongy-stuffed and the pileus orbicular, fixed at the center and more than usually reticulate-rugose on the surface. This view is strengthened by the fact, which Hooker states, that the two species were found growing together.

In reviewing Klotzsch's work in 1839, Berkeley lists *Boletus reticulatus* as synonymous with *Boletus tenuis* and enlarges Hooker's description from the original specimens, explaining that the monstrous form in question was caused by the accidental reversal of the log or branch upon which it grew and that the spongy-stuffed pores were due to the beginning of a new pileus, while the abnormal reticulations on the surface were caused by a new hymenium beginning to form on the old pileus. This leaves practically no doubt as to the identity of the two species; but since the first name is antedated by one of Schaeffer's, *Boletus tenuis* would hold for our plants in spite of the doubt.

The Cuban plant, finely described and figured by Montagne, appears in the figure to have larger pores than plants from elsewhere, but the type collections do not indicate that it is specifically different.

Peck's species, described from plants collected by J. J. Brown on the Roatan Islands off the coast of Honduras, is well represented by a number of specimens collected recently in Honduras by Wilson, and I do not find it distinct in its mature stages from Hooker's plant. The fresh young sporophores have a strong resemblance, as Peck says, to forms of *Agaricus confragosus.*

This species is fairly common and, in some localities, rather abundant in tropical America. Among the plants examined the following may be mentioned: Guayaquil, *Lagerheim;* Colombia, *Baker;* Nicaragua, *C. L. Smith, Shimek;* Honduras, *Wilson 4, 410, 449;* Mexico, *C. L. Smith;* Cuba, *Wright 315, Wilson.*

2. **Favolus variegatus** (Berk.)

Hexagona variegata Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852. Proc. Amer. Acad. Arts & Sci. **4**: 122. 1858.

This species was first described from plants collected in San Domingo, as follows:

"Pileo tenui coriaceo dimidiato rugoso crebri-zonato multicolori velutino; hymenio umbrino poris mediis."

It is a very showy plant and rarely escapes the collector, being large and much expanded, with surface brilliantly marked with variegated zones of red and brown tints. The typical form occurs in southern Florida and the West Indies in fair quantity, while it ranges either in this form or in one with smaller pores, called var. *membranacea* at Kew, to various parts of Central America and into South America. The well-known tendency of species in this genus to vary in pore measurement prevents me from founding a species on the variety just mentioned. Possibly when more is known of the plants in the field, such a separation may be found desirable.

Specimens are at hand from Florida, *Calkins, Small & Nash, Small & Carter;* Costa Rica, *Endres;* Nicaragua, *Wright, C. L. Smith;* Mexico, *Egeling;* Colombia, *Baker;* Brazil, *Glaziou, Balanza;* Peru, *Pearce;* Bolivia, *Bang.*

SPECIES INQUIRENDAE

Hexagona papyracea Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 379. 1843. Described from some unknown locality; possibly from

Brazil. The pileus is said to be nine inches broad, five inches long and as thin as paper, resembling most a species gathered by Schomburgk in Brazil communicated by Berkeley to Montagne under the name of *Hexagona variegata*, but considered by him only a non-setose state of his *Hexagona aculeata*.

A specimen in the herbarium of the Agricultural Department at Washington, collected by Wright in Nicaragua and labeled *Hexagona papyracea* Berk., differs from plants ordinarily called *Hexagona variegata* in its thinner, flexible pileus and smaller, stag-colored pores. There is such a specimen also in the herbarium of the New York Botanical Garden collected in the Peruvian Andes by Pearce and marked *Hexagona variegata* Berk. Both of these specimens, however, are only var. *membranacea* of *Hexagona variegata*, as type plants at Kew show.

Hexagona cingulata Lév. Ann. Sci. Nat. III. Bot. **2**: 200. 1844. Described from material collected in Hispaniola as follows:

"Pileo coriaceo reniformi membranaceo nudo zonato pallide cinereo nitente, alveolis mediis fuscis e rotundo hexagonis intus cinereis."

"Petite espèce réniforme, nue, zonée, de couleur pâle cendrée, et brillante, large de 2 à 4 centimètres; ses alvéoles sont parfaitement régulières, de moyenne grandeur, fauves, obtuses à la marge, et cendrées a l'intérieur."

From the above description this species can hardly be different from *Favolus tenuis* (Hook.).

Hexagona leprosa Fr. Nov. Symb. 101. 1851. Described as follows:

"Pileo suberoso crasso pulvinato laevigato leproso-pruinoso umbrino, alveolis profundis amplis acutis fusco-umbrinis, intus nudis."

"In Insula San Jan, Indiae occidentalis. Oersted."

Plants of this name at Kew are very distinct from other North American species, being much thicker and having much longer tubes, reminding one somewhat of a wasp's nest. Further study is necessary before their exact relations are known.

Hexagona unicolor Fr. Nov. Symb. 101. 1851. Described from "America calidiori" as follows:

"*H. unicolor*, dilute ferruginea, pileo coriaceo rigido subflexili applanato concentrice sulcato glabro, alveolis mediis vadosis angulatis."

The following notes are appended to the description:

"Pileus dimidiatus, sessilis, peltato-adnatus, reniformis, 2 unc. circiter transversim latus, passim plures imbricati, dilute ferrugineus, non priorum instar incrassatus, sed tenuis applanatus subflexilis, rigescens tamen, sulcis concentricis concoloribus exaratus (nec a basi radiato-rugosus), glaber. Margo acutus, passim incisus, concolor. Contextus floccosus, dilute ferrugineus. Pori medii, regulares, 4–6-goni, obtusiusculi, dilute cinnamomei.—Inter fungos Americanos inveni, sed locum specialem ignoro."

The type of the species I have not seen, but the description indicates that it is not far from *Favolus tenuis* (Hook.). This opinion is strengthened by comparing *Hexagona fasciata* Berk., which Fries says is very near his *Hexagona unicolor*.

Certain resupinate forms, such as *Hexagona carbonaria* B. & C. (Grevillea **1**: 68. 1872), *Hexagona pallens* Sacc. (Misc. Myc. **2**: 14. 1884) and *Hexagona vittata* Ell. & Macbride (Bull. Iowa Lab. Nat. Hist. **4**: 68. 1896), described from South Carolina, Mexico and Nicaragua respectively, hardly come within the scope of the present paper.

NEW YORK BOTANICAL GARDEN.

Further observations on Taxodium

Roland M. Harper

Since the publication of my paper on *Taxodium distichum* and related species * I have spent three more seasons in the coastal plain of Georgia, where I have now had the southeastern representatives of this genus under observation every month in the year except December, and I am now able to present some additional notes on them.

One reviewer of that paper (who is among the foremost of American phytogeographers, but not a professed systematist) has expressed the opinion "that *Taxodium imbricarium* will prove to be merely an ecological variety" of *T. distichum.* If this is the case, then some hundreds if not thousands of long established and universally accepted species will have to be placed in the same category. But the fact that these two species remain perfectly distinct when cultivated in the same soil (as noted on the last page of my previous paper), not to mention the considerable difference in their geographical distribution, ought to dispose of the "ecological variety" question. From all the evidence at hand at the present writing the conclusion is irresistible that *T. imbricarium* is abundantly distinct. The only substantial argument which could be urged against the recognition of this species is the occurrence of trees intermediate (in some characters at least) between it and *T. distichum.* But these are outnumbered a hundred to one (in Georgia at least) by typical and unmistakable specimens of *T. imbricarium,* † and should not invalidate the species any more than the intermediate forms in countless other genera do.

My work will doubtless admit of some criticism from a geological standpoint, however. My attention has been called by a geologist friend to the fact that what has been passing under the

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* Bull. Torrey Club **29**: 383–399. June, 1902.

† I have records of three or four hundred stations in Georgia for *T. imbricarium,* at each of which there may be from ten to several thousand individuals; while the intermediate form I have seen only about twenty times, and never more than a hundred trees at a time.

name of the Lafayette formation in Georgia and some other states is probably divisible into two or three different horizons. One of these may be the Grand Gulf, which has recently been a subject of considerable controversy.* Until geologists have settled this point among themselves I can make no satisfactory corrections in this respect. However, when the whole truth is known these two species of *Taxodium* will surely be found to stand always in some such relation to the superficial formations as I have already indicated, whether my present identification of these formations is correct or not.

It is absolutely certain though that *Taxodium distichum* grows

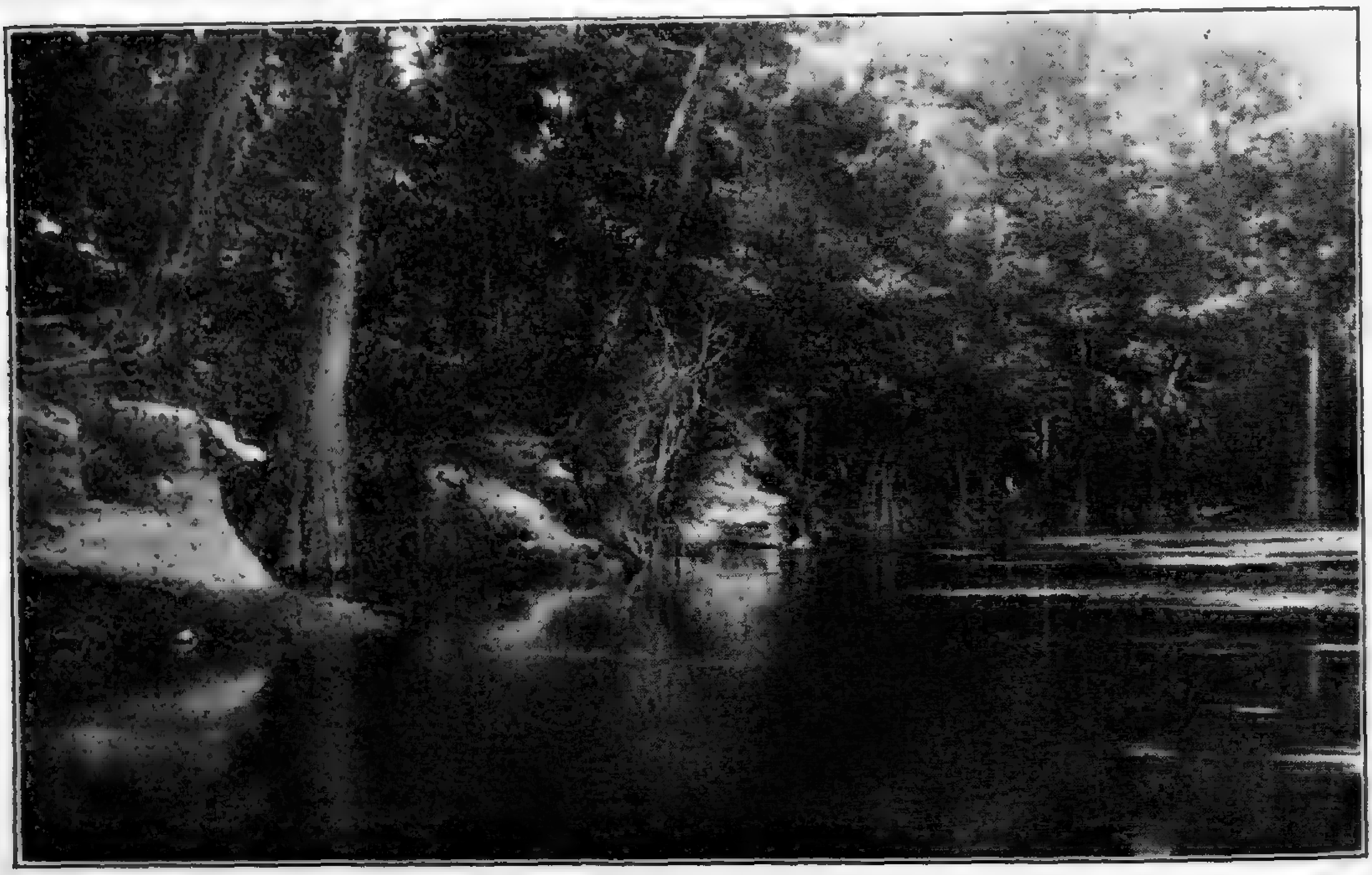

FIGURE 1. *Taxodium distichum* growing on Lower Oligocene rocks on right bank of Flint River, Sumter County. July 5, 1902.

directly on the underlying rocks of the coastal plain, as I had excellent opportunity to observe on the Flint River east of Americus in July, 1902, when the water was unusually low for that time of year (see *figure 1*). And similar conditions have doubtless existed for thousands of years, for according to Bibbins † fos-

* For a discussion of the nomenclature, relationships and distribution of this formation the reader is referred to the following papers in Science (new series), all entitled "The Grand Gulf Formation": — Smith & Aldrich, 16: 835–837. November 21, 1902; Dall, 16: 946, 947. December 12, 1902; Smith & Aldrich, 18: 20–26. July 3, 1903; Dall, 18: 83–85. July 17, 1903; Hilgard, 18: 180–182. August 7, 1903.—See also Dall, Trans. Wagner Free Inst. Sci. 3: 1561–1564. 1903.

† Plant World 1: 164–166. August, 1898.

sil cypress stumps have been found on the shores of Chesapeake Bay with their roots imbedded in Cretaceous strata. It was at first supposed that the stumps themselves were of Cretaceous age, but subsequent investigations by the same author and Dr. Hollick have shown that the trees grew in Pleistocene times, sending their roots down into the Cretaceous strata on which they stood, and the stumps have been preserved *in situ*.

The actual contact of *T. imbricarium* with the Lafayette formation (or what passes for it) has not yet been observed, and could hardly be without having special excavations made for the purpose, but I have often seen this formation exposed (particularly in railroad cuts) within a few yards of colonies of this tree.

The relations of the two species under consideration to the geological formations are well illustrated at Bull Head Bluff on the Satilla River in Camden County, Georgia, which I visited in August, 1902. The bluff is about eight feet high, and exhibits the following section, in descending order: Two feet of Columbia sand, five feet of reddish clay (Lafayette?), and about a foot of stiff bluish clay (doubtless Tertiary, but exact age unknown). Typical *Taxodium distichum* grows here along the water's edge, below the Lafayette, while a hundred yards or so away from the river equally typical *T. imbricarium* flourishes in moist pine-barrens.

Ecologists have had a good deal to say recently about drained and undrained swamps, and the remarkable differences in their flora. If they would examine the habitats of the two taxodiums they would find that *T. distichum* always grows in "drained" swamps, and *T. imbricarium* usually in ponds, which are of course "undrained." In the Southeastern States, as in other parts of the country, there are very few species common to both habitats. In their relation to limestone the taxodiums are equally distinct, *T. distichum* being essentially a limestone-loving species and *T. imbricarium* just the opposite. (The latter often, perhaps always, grows over limestone, but never in contact with it, some more recent formation always intervening.)

There are also some additional morphological characters which I overlooked before, by which the two species under consideration may be distinguished. In Washington in the spring of 1902 my attention was called by Dr. J. N. Rose to a difference in the bark of cultivated specimens, that of *T. imbricarium* (cultivated there under the name of *Glyptostrobus*) being considerably thicker and more coarsely ridged than that of *T. distichum.* On my return to the field I soon found that the same was a constant and well-defined character of the wild trees, and it has since been of considerable assistance to me in studying their distribution, particularly in the winter months when the leaves were fallen.

There is also a marked difference in the knees, those of *T. imbricarium* being short and rounded, often almost hemispherical, while those of *T. distichum* are usually slender and acute, sometimes reaching a height of six feet (in the Suwannee River in Clinch County, for instance). The latter species seems to produce knees much more abundantly, Elliott's opinion to the contrary notwithstanding. In both species the height of the knees and that of the enlarged base of the trunk usually indicates the maximum level of the water in which they grow,* with the exceptions that in deep ponds the knees of *T. imbricarium* are entirely submerged or perhaps wanting, and in many creek swamps those of *T. distichum* are very small and do not grow as high as the enlargement of the trunk. In May, 1904, I saw in the pine-barrens near Douglas, Georgia, in a place which had once been a small mill-pond, some saplings of *T. imbricarium* with trunks perceptibly enlarged up to about six feet from the ground, which was just the height of the dam. In cultivation, where they are never inundated, it has been my observation that each species produces a slight but characteristic enlargement of the trunk. (The specimens on the grounds of the Smithsonian Institution and Department of Agriculture in Washington are good examples.) This does not agree with the recently published observations of Dr. S. M. Coulter.† In wet pine-barrens, where there is likewise no inundation, the enlargement of the base of *T. imbricarium*, though insignificant compared with what it is in ponds, is always present (see *figure 4*). In any one stream or pond the enlarged bases are all the same height, regardless of the size of the tree.

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* This was noted in the case of *T. distichum* by Dickeson and Brown in a paper on the cypress timber of Mississippi and Louisiana, in 1848 (Am. Jour. Sci. II. **5**: 15–22).

† Rep. Mo. Bot. Gard. **15**: 59. *pl. 15–18.* 1904.

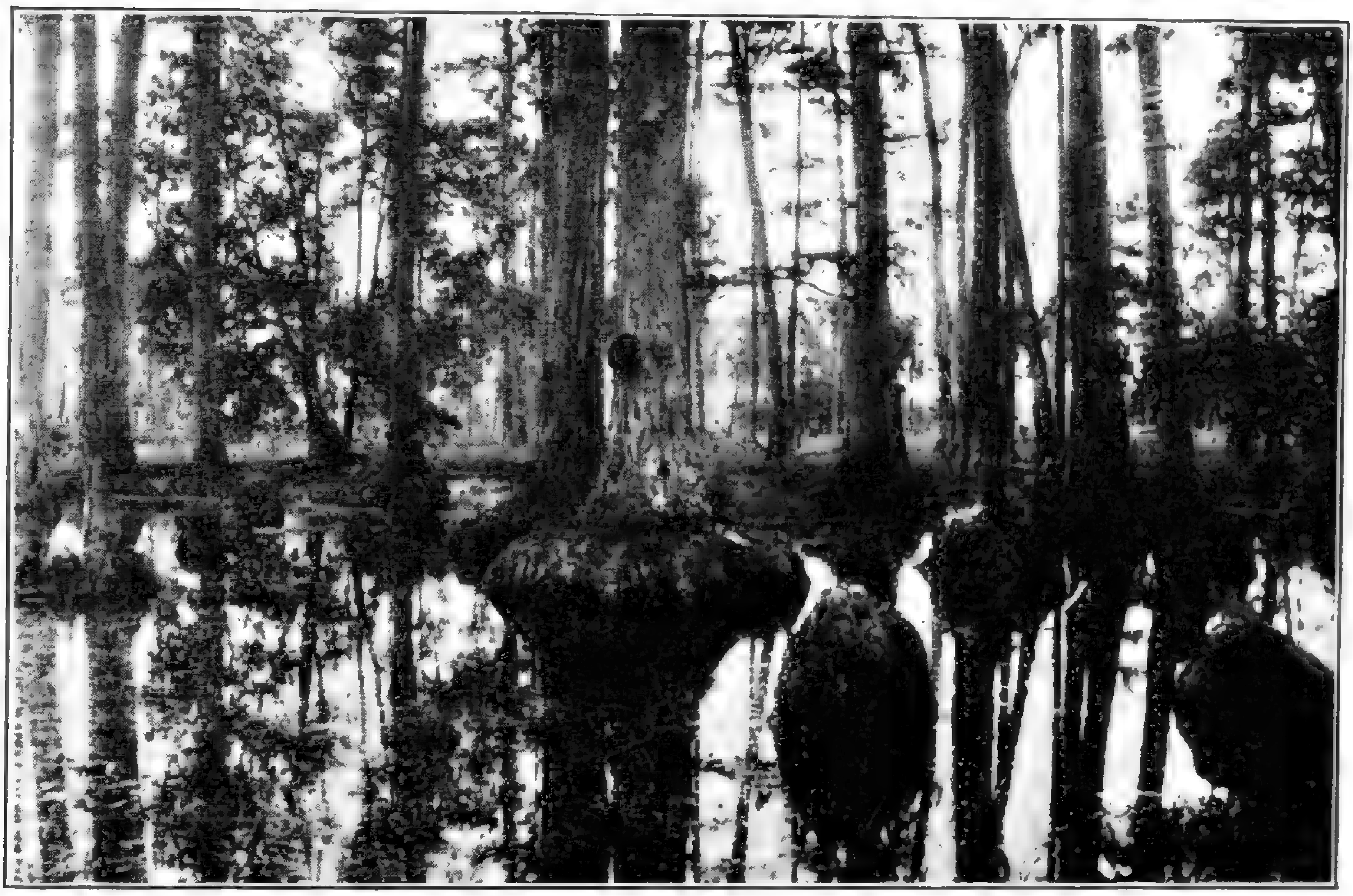

FIGURE 2. *Taxodium imbricarium* in a shallow pine-barren pond in Coffee County. July 24, 1902. Note the rounded knees and the very abrupt enlargement of the trunks. The water-level in this pond probably does not vary more than a foot or two.

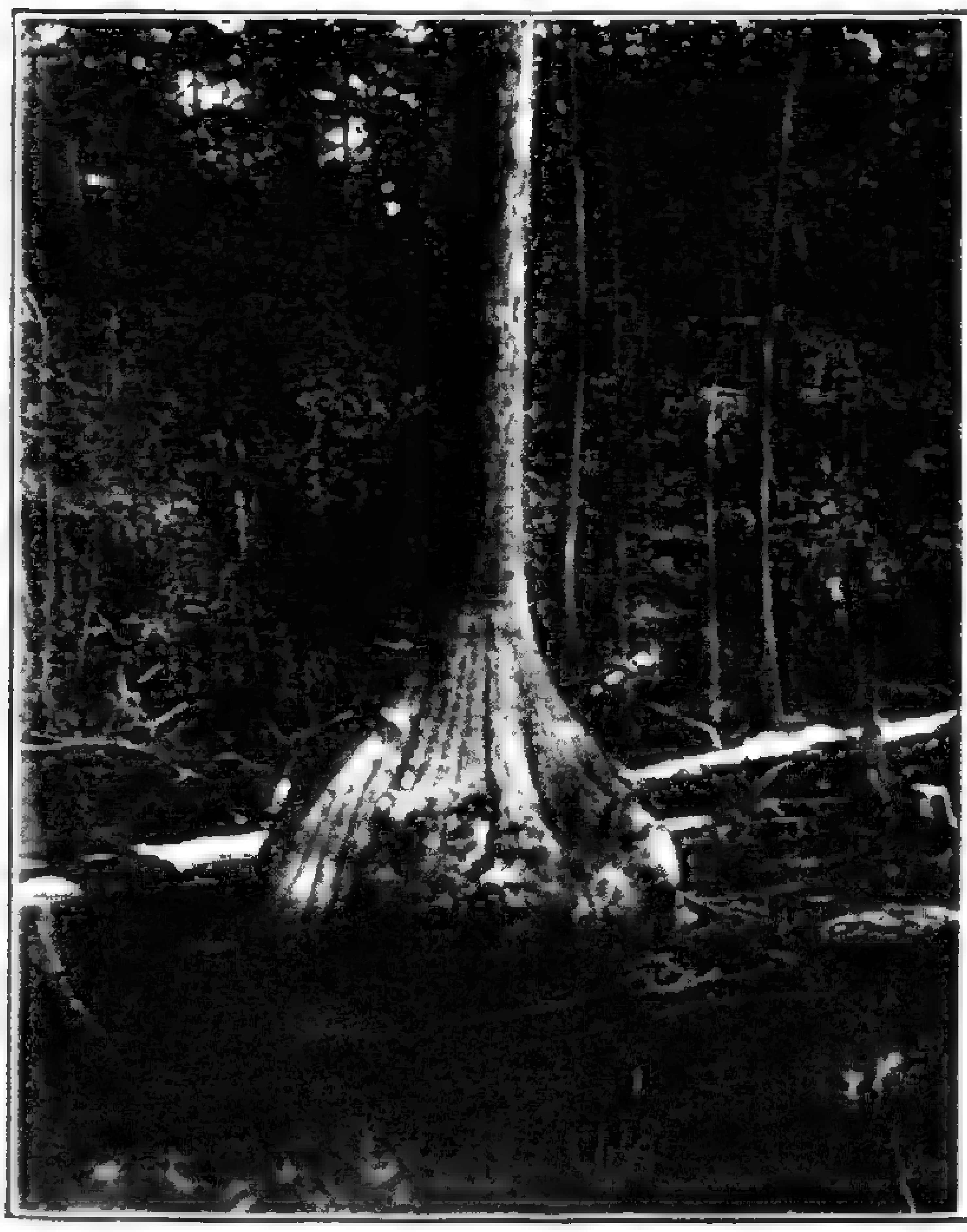

FIGURE 3. *Taxodium imbricarium* in Twenty Mile Creek, Coffee County. Sept. 24, 1900. Note the greatly enlarged base of the trunk and its broad rounded ridges.

FIGURE 4. *Taxodium imbricarium* in wet pine-barrens near Douglas, Coffee County. Base of trunk not conspicuously enlarged. Several specimens of *Pinus Elliottii* in background. Feb. 3, 1904.

An examination last winter of some specimens of *T. imbricarium* which had been felled, showed the structure of the base of the trunk in cross-section. The broad longitudinal ridges of wood become pressed against each other as they grow, closing the sinuses between them (as shown in the accompanying diagrams), while in *T. distichum* the sinuses are open and rounded and the ridges rather sharp. Ericaceous shrubs (such as *Pieris nitida* and *Leucothoe racemosa*), growing close to the base of such a tree, often have their stems caught in the embrace of the swelling ridges and then appear as if growing out of the *Taxodium* above the ground. The climbing habit of *Pieris phillyreaefolia* * may have originated in some such way. In both species the base seems to be always hollow in old specimens, and knees often grow inside it.

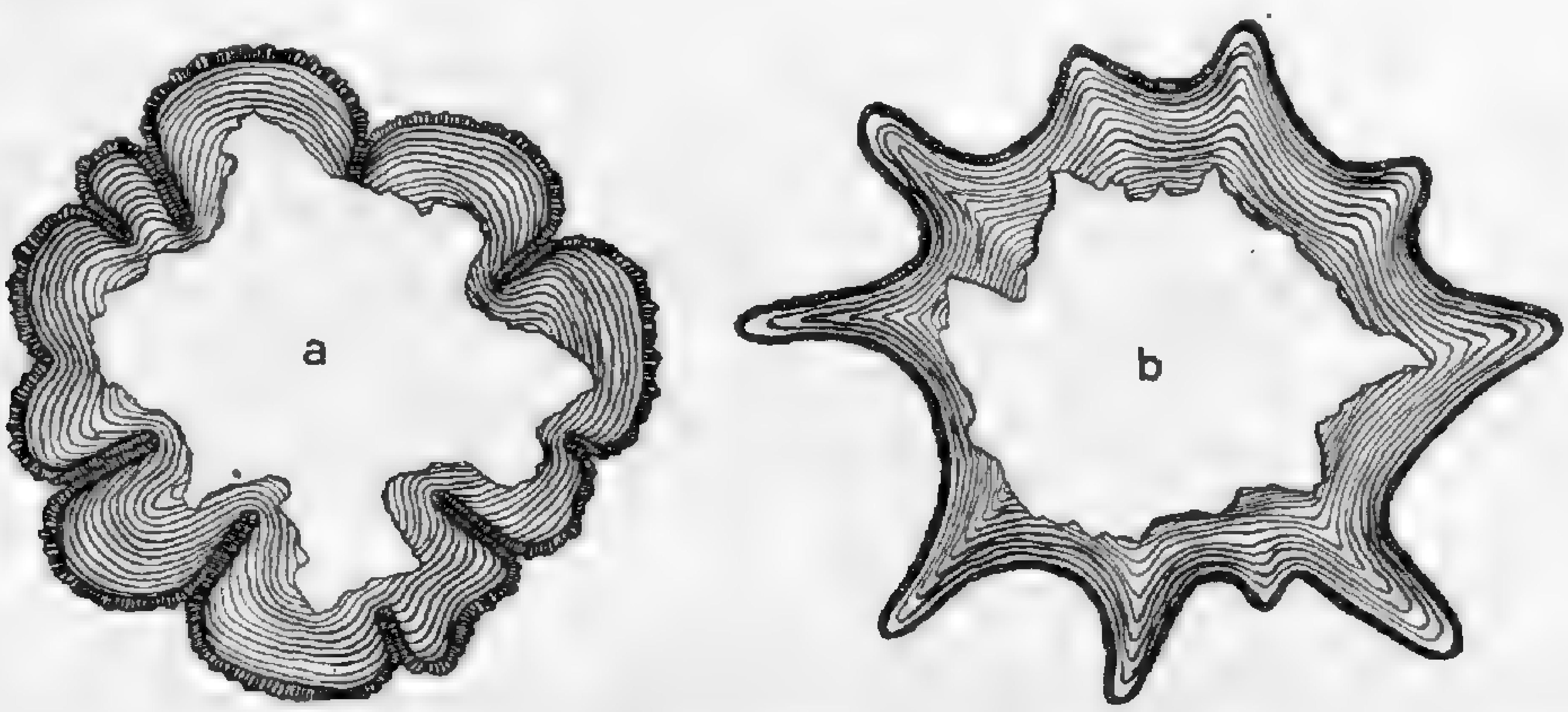

FIGURE 5. Ideal cross-sections of hollow enlarged base of trunk of *Taxodium imbricarium* (*a*) and *T. distichum* (*b*). (The annual rings in reality would be ten to fifty times as numerous as they are shown here.)

Another distinction (though rather a subtle one) between these two species is that in *T. distichum* the trunk is straight but not always erect, while in *T. imbricarium* it is erect but not always straight.

The following additional notes on the distribution of the two southeastern species may be of interest.

TAXODIUM DISTICHUM

In Georgia the inland limit of this species reaches the fall-line at the eastern border of the state, but diverges widely from it westward, following approximately the outcrop of the Eocene forma-

* See Torreya 3 : 21, 22. February, 1903.

tions. On the Savannah River it ascends just to Augusta; on the Ogeechee and its tributaries it terminates somewhere between Louisville in Jefferson County and the Augusta Southern R. R. in Glascock; on the Oconee it is common in Laurens and Montgomery Counties, but terminates at or near the Central R. R. bridge in Washington and Wilkinson; on the Ocmulgee it ascends to Twiggs and Houston Counties; on the Flint to Macon County (I am told), but not quite to the twin cities of Oglethorpe and Montezuma; and on the Chattahoochee I have seen it only in Early County near Saffold, though it grows in low grounds near the river at Columbia, Alabama, several miles farther up. On the smaller rivers which rise below the fall line (and are therefore not muddy), it ascends the Satilla to Bull Head Bluff or beyond, the St. Mary's nearly to its head at the southeastern corner of Okefinokee Swamp, the Withlacoochee to Lowndes County, and the Ochlocknee to Moultrie. (It is mostly in some of these smaller rivers, such as the Canoochee, Ohoopee, Satilla, Suwannee, Allapaha and Withlacoochee, that the puzzling intermediate forms occur.) Near the coast, in the counties of Glynn and Camden in Georgia and Nassau in Florida, this species occurs away from the rivers in numerous extensive swamps, the character of whose flora points strongly to the absence of the Lafayette formation.

Its most frequent associates in Georgia are *Hicoria aquatica*, *Planera aquatica*, and *Nyssa aquatica* (*N. uniflora*).

Dr. R. Ellsworth Call * has published some interesting notes on the occurrence of *Taxodium distichum* in eastern Arkansas, in which he says among other things: "From the top of Crowley's Ridge, looking either to the east or the west, at those points which command the valleys of the St. Francis and the Cache, the cypress areas can be readily made out by the observer. The tops of the giant trees tower far above the heads of the intervening forests and give one the location of the swamps for hundreds of square miles."

Some outlying stations for this species in the Edwards Plateau of Texas (which includes Kerrville, mentioned in my previous paper) have been described by Hill and Vaughan,† who say in part: "The occurrence of the cypress is a peculiar anomaly. This tree,

* Rep. Geol. Surv. Ark. 1889[2]: 198–200. 1891.

† Ann. Rep. U. S. Geol. Surv. 18[2]: 210, 211. 1898.

which ordinarily grows only in the swamps and bayous of the low subcoastal regions, attains an enormous size at the edge of the deeper holes near the heads of permanent water of the Pedernales . . . and other streams. These localities are at altitudes from 1,000 to 1,750 feet above the sea, hundreds of miles west of the great cypress swamps of the eastern tier of Texan counties, with which they have no possible continuity." (See also Bray, U. S. Dept. Agric., Bureau of Forestry Bull. 47: 53; 49: 16. 1904.)

TAXODIUM IMBRICARIUM

This species is very abundant in the coastal plain of Georgia, where I have seen it in every county in which Oligocene or later rocks occur, *i. e.*, from the inland edge of the pine-barrens to Florida and the coast. On the way to Georgia in 1903 I saw it in Moore County, N. C., near the fall-line,* and in Hampton County, S. C. It is common in Nassau and Baker Counties in Florida, but no data are yet available as to its southern limit in that state.

Outside of the pine-barrens in Georgia there are several outlying stations for it, where it grows in shallow ponds. These have been noted as follows: In Richmond County between Adam and Adventure, in Jefferson near Wadley, in Washington near Sandersville, in Taylor near Reynolds, and in Terrell between Bronwood and Dawson. All these localities, according to the best information at present obtainable, seem to be underlaid by rocks of the Claibornian division of the Eocene. The Taylor County station is of interest as being the farthest inland, and most remote from the pine-barrens. At this point the *Taxodium* is in imminent danger of extinction, most of the trees having been already cut and used up (it being apparently the only cypress pond known in the vicinity), and few if any young trees were seen. The principal vegetation of this pond is *Liquidambar*, with a few *Crataegus aestivalis* bushes.

Toward the coast *Taxodium imbricarium* extends nearly to Brunswick, within two or three miles of salt water and not over ten miles from the open ocean. There its habitat and associates are much the same as they are fifty or a hundred miles inland.

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* See Torreya **3**: 123. August, 1903.

This turns out to be the predominating tree in Okefinokee Swamp, as already announced,* where it grows in all the sphagnous bogs, with *Pinus Elliottii*, ferns, *Dulichium*, *Eriophorum virginicum*, aroids, orchids, *Drosera*, *Sarracenia*, *Ilex*, ericaceous shrubs, etc., just as several other conifers do in the cedar-swamps and peat-bogs of the North. It is said to attain enormous dimen-

FIGURE 6. View of Cane Water Pond, Decatur County, showing a group of saplings of *Taxodium imbricarium* in center, and branches of two older trees at the sides. Aug. 6, 1903. Note the gradually tapering trunks of the saplings (doubtless due to great variations in water-level), and the erect leaf-bearing branchlets on all the trees.

sions there, but I did not penetrate far enough into the heavily timbered portions of the swamp to verify this. Elsewhere in Georgia it is nearly always associated with *Pinus Elliottii*, and commonly with *Pinus serotina*, *Dichromena latifolia*, *Ilex myrtifolia*, *Magnolia glauca*, *Hypericum fasciculatum*, *Nyssa biflora*, *Oxypolis filiformis* and *Pinckneya pubens*.

The natives in Georgia do not seem usually to make any dis-

* See Torreya 2: 157. Oct. 1902; and Science II. 17: 508. 27 March, 1903.

FIGURE 7. Nearly pure association of *Taxodium imbricarium* in a shallow pond (dry at the time the photograph was taken) about three miles east of Valdosta, Lowndes County. Feb. 13, 1904. Note the rather coarsely ridged bark, the erect trunks, and their enlarged bases all of the same height. One or two saplings of *Pinus Elliottii* are visible.

tinction between the two species of cypress. Lumbermen recognize several varieties, such as white, black and red cypress, based on the appearance of the wood, but as they do not correlate these with any leaf or bark characters, I cannot see but what all these names apply to *T. distichum*, which furnishes practically all the cypress lumber on the market. *T. imbricarium* is used to some extent for posts, telegraph poles, and crossties, but just why it is not used for lumber I have not satisfactorily ascertained. Elaborate preparations were made several years ago for getting this species out of Okefinokee Swamp and sawing it up, but for various reasons this enterprise was abandoned after it had been in operation a short time. The danger which thus threatened what is probably the finest body of *Taxodium imbricarium* in existence, which it has taken Nature thousands of years to accumulate, is not altogether past, but may be revived at any time. It is to be hoped that rational methods of lumbering will be universally adopted before the devastation of Okefinokee Swamp is again undertaken.

The illustrations selected to accompany this paper are mostly of *T. imbricarium*, as botanists will be more familiar with the other species, which has often been described and figured. The most conservative should now admit that for phytogeographical purposes at least it is much more desirable to regard the two species here discussed as distinct.

COLLEGE POINT, NEW YORK.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Beal, W. J. The vascular bundles in an apple. Science II. **20**: 889. 23 D 1904.

Berger, A. Opuntias. Gard. Chron. III. **35**: 34. *f. 14–16.* 16 Ja 1904.

Three new species of *Opuntia*, described from garden material by Weber.

Bessey, E. A. Ueber die Bedingungen der Farbbildung bei *Fusarium.* Flora **93**: 301–334. 10 Au 1904.

Blanchard, W. H. A new species of blackberry. Rhodora **6**: 223–225. 30 N 1904.

Rubus recurvans sp. nov.

Bower, F. O. Plant morphology. Science II. **20**: 524–536. 21 O 1904.

Brainerd, E. Hybridism in the genus *Viola.* Rhodora **6**: 213–223. *pl. 58.* 30 N 1904.

Braunton, E. Flora of Amador County [California]—Aug.–Nov. collections. Preston School Outlook **4**$^{4-7}$: 18. D 1904.

Burnham, E. J. An adventitious bud. Nature Study (N. H.) **5**: 1–4. Je 1904. [Illust.]

Burnham, E. J. Mayflower seeds. Nature Study (N. H.) **5**: 21–23. Jl 1904. [Illust.]

Burns, G. P. Regeneration and its relation to traumatropism. Beih. Bot. Centralb. **18**^{1}: 159–164. *f. 1–4.* 1904.

Bush, B. F. The Texas tradescantias. Trans. Acad. Sci. St. Louis **14**: 181–193. 30 D 1904.

Recognizes 18 Texas species of *Tradescantia*, of which 10 are described as new.

Carleton, M. A. Investigations of rusts. U. S. Dept. Agr. Plant Ind. Bull. 63: 1–29. *pl. 1, 2.* 12 Jl 1904.

Chodat, R. & Hassler, E. Plantae Hasslerianae soit énumération des plantes récoltées au Paraguay. Bull. Herb. Boiss. II. **4**: 1051–1068. 30 S 1904; 1155–1172. 31 O 1904; 1273–1288. 5 D 1904.

Includes new species in *Verbena* (4), *Lantana* (3), *Lippia* (11), *Stachytarpheta*, *Casselia* (2), *Aegiphila* (4), *Aberemoa*, *Anona* (2), *Rollinia* (3), *Tibouchina*, *Miconia* and *Fagara* (2).

Christ, H. Primitiae florae costaricensis. *Filices* et *Lycopodiaceae* III. Bull. Herb. Boiss. II. **4**: 936–951. 31 Au 1904; 957–972. 30 S 1904; 1089–1104 31 O 1904.

Includes new species in *Hymenophyllum* (12), *Trichomanes* (2), *Cyathea* (9), *Alsophila* (5), *Aspidium* (5), *Gymnopteris*, *Athyrium* (3), *Diplazium* (2), *Asplenium* (3), *Lomaria* (3), *Adiantum* (3), *Gymnogramme* (3), *Saccoloma* and *Polypodium* (3).

Clark, A. G. *Dalibarda repens* near Boston. Rhodora **6**: 227. 30 N 1904.

Cook, O. F. The vegetative vigor of hybrids and mutations. Proc. Biol. Soc. Wash. **17**: 83–90. 9 Ap 1904.

Copeland, E. B. New or interesting California fungi II. Ann. Myc. **2**: 507–510. *pl. 12.* 10 D 1904.

Includes new species in *Omphalia*, *Coprinus*, *Polyporus*, *Trametes*, *Solenia*, *Verpa* and *Helvella* (2).

Coulter, J. M. Development of morphological conceptions. Science II. **20**: 617–624. 11 N 1904.

Dammer, U. Eine neue Palme aus Guatemala. Notizbl. Königl. Bot. Gart. Berlin **4**: 157, 158. 16 D 1904.

Nalortiea Tuerckheimii sp. nov.

Darwin, F. On the perception of the force of gravity by plants. Pop. Sci. Mo. **65**: 532–536. *f. 1.* O 1904.

Davis, W. T. The ripening of the fruit of chokeberries. Proc. Nat. Sci. Assoc. Staten Island **9**: 32. 12 N 1904.

Demcker, R. Malerische Vegetationsbilder aus Nord-Amerika. Mitteil. Deuts. Dendr. Gesells. **13**: 148–155. 1904.

Fawcett, W. & Rendle, A. B. An account of the Jamaican species of *Lepanthes*. Trans. Linn. Soc. Bot. II. **7**: 1–13. *pl. 1, 2.* D 1904.

Recognizes 12 species, of which 5 are described as new.

Fedde, F. Species novae generis *Eschscholtziae*. Notizbl. Königl. Bot. Gart. Berlin **4**: 153. 16 D 1904.

Descriptions of 3 new species.

Fürstenberg, M. von. Dendrologische Studien im westlichen Canada (British-Columbia). Mitteil. Deuts. Dendr. Gesells. **13**: 25–40. *pl. 1.* 1904.

Gagnepain, F. Zingiberacées et Marantacées nouvelles de l'herbier du Muséum (12e note). Bull. Soc. Bot. France **51**: 164–182. My 1904.

Including *Thalia trichocalyx* sp. nov., from tropical America.

Gandoger, M. *Myzodendron antarcticum*, plante nouvelle de l'Amérique australe. Bull. Soc. Bot. France **51**: 141–144. Ap 1904.

Native of Patagonia.

Gifford, J. Southern Florida. Notes on the forest conditions of the southernmost part of this remarkable peninsula. Forestry & Irrig. **10**: 406–413. S 1904. [Illust.]

Gleason, H. A. Notes from the Ohio State Herbarium. I. Ohio Nat. **5**: 249, 250. 14 D 1904.

Gürke, M. *Cereus Urbanianus* Gürke & Weingart. Notizbl. Königl. Bot. Gart. Berlin **4**: 158, 159. 16 D 1904.

A new species from Haiti.

Hennings, P. *Fungi* amazonici III a cl. Ernesto Ule collecti. Hedwigia **43**: 351, 352. 12 Je 1904; 353–400. *pl. 5.* 3 S 1904.

Includes 95 new species in 54 genera, of which 14 are new.

Hinckes, R. T. Rambles in Chile: many garden flowers at home. Garden **65**: 143, 144. 27 F 1904.

Höck, F. Ankömmlinge in der Pflanzenwelt Mitteleuropas während des letzten halben Jahrhunderts. X. Beih. Bot. Centralb. 18^2: 79–112. 1904.

Holdt, F. von. Der Baumwuchs unter künstlicher Bewässerung. Mitteil. Deuts. Dendr. Gesells. **13**: 163, 164. 1904.

Hollick, A. Botanical notes. Proc. Nat. Sci. Assoc. Staten Island **9**: 25, 26. 15 O 1904.

Hollick, A. Palaeobotany, or fossil botany. Encyclopedia Americana **11**: —. 1904.

Hollick, A. A recent discovery of amber and other fossil plant remains at Kreischerville. Proc. Nat. Sci. Assoc. Staten Island **9**: 31, 32. 12 N 1904.

Holt, G. W. *Subularia* at East Andover, New Hampshire. Rhodora **6**: 228. 30 N 1904.

House, H. D. A new violet from New England. Rhodora **6**: 226, 227. *pl. 59.* 30 N 1904.

Viola Novae-Angliae sp. nov.

Jensen, J. Ursachen des verschiedenen Verhaltens einzelner Gehölze auf Höhenboden und in der Ebene. Mittell. Deuts. Dendr. Gesells. **13**: 164–167. 1904.

Kneucker, A. Bemerkungen zu den "*Carices* exsiccatae" XII Lieferung 1904. Allgem. Bot. Zeits. **10**: 189–194. 15 D 1904.

Koehne, E. Zur Kenntnis der Gattung *Philadelphus.* Mitteil. Deuts. Dendr. Gesells. **13**: 76–86. 1904.

Kränzlin, F. *Catasetum monodon.* Gard. Chron. III. **35**: 354. 4 Je 1904.

A new species from Brazil.

Kusnezow, N. J. Subgenus *Eugentiana* Kusn. generis *Gentiana* Tournef. Act. Hort. Petrop. **15**: 321–506. O 1904.

Malme, G. O. A. Die Umbelliferen der zweiten Regnell'schen Reise. Ark. Bot. 3^{13}: 1–22. *pl. 1–3.* 19 O 1904.

Includes descriptions of four new species and two new varieties of *Eryngium.*

Mast, W. H. Forest tree seed collecting in New Mexico. Forestry & Irrig. **10**: 309–312. Jl 1904.

Mez, C. Additamenta monographica 1904. Bull. Herb. Boiss. II. **4**: 619–634. 30 Je 1904; 863–878. 31 Au 1904; 1121–1136. 31 O 1904.

New species in *Greigia*, *Aechmea* (2), *Billbergia*, *Pitcairnia* (9), *Puya* (9), *Lindmania*, *Vriesia* (9), *Thecophyllum* (19), *Catopsis* (5) and *Tillandsia* (12).

Mez, C. Physiologische Bromeliaceen-Studien. I. Die Wasser-Oekonomie der extrem atmosphärischen Tillandsien. Jahrb. Wiss. Bot. **40**: 157–229. *f. 1–26.* 1904.

Miller, G. S. The species of *Geum* occurring near Washington. Proc. Biol. Soc. Wash. **17**: 101. 9 Ap 1904.

Nelson, A. A decade of new plant names. Proc. Biol. Soc. Wash. **17**: 99, 100. 9 Ap 1904.

Nelson, A. New plants from Nevada. Proc. Biol. Soc. Wash. **17**: 91–98. 9 Ap 1904.

New species in *Arabis*, *Viola*, *Mirabilis*, *Sidalcea* (2), *Sphaeralcea*, *Sphaerostigma*, *Phacelia*, *Mertensia*, *Pentstemon* (2) and *Lagophylla*.

Nelson, A. Plantae Andrewseae. Proc. Biol. Soc. Wash. **17**: 173–179. 27 D 1904.

New species and varieties in *Asplenium*, *Nemexia*, *Crataegus*, *Eustoma*, *Pleurogyne*, *Mimulus*, *Erigeron* and *Aster*.

Olive, E. W. Mitotic division of the nuclei of the *Cyanophyceae*. Beih. Bot. Centralb. **18**[1]: 9–44. *pl. 1, 2.* 1904.

Osterhout, W. J. V. Contributions to cytological technique. Univ. Calif. Publ. Bot. **2**: 73–90. *f. 1–4.* 15 Je 1904.

Palmer, W. *Gyrostachys simplex* in Virginia. Proc. Biol. Soc. Wash. **17**: 165. 27 D 1904.

Pammel, L. H. Forest conditions in western Wisconsin. Forestry & Irrig. **10**: 421–426. S 1904. [Illust.]

Penhallow, D. P. Notes on Tertiary plants from Canada and the United States. Trans. Roy. Soc. Canada, **10**[4]: 57–76. 1904.

Includes descriptions of new fossil species of *Taxodium* and *Cupressoxylon*.

Perkins, G. H. Description of species found in the Tertiary lignite of Brandon, Vermont. Rep. State Geol. Vt. **1903–04**: 174–212. *pl. 75–81 + f. 8.* 1904.

Includes 104 new species and the following new genera: *Monocarpellites*, *Hicoroides*, *Bicarpellites*, *Brandonia*, *Rubioides*, *Sapindoides* and *Prunoides*.

Perkins, G. H. On the lignite or brown coal of Brandon and its fossils. Rep. State Geol. Vt. **1903–04**: 153–162. *f. 6.* 1904.

Purpus, A. Die Gehölzvegetation des nördlichen Arizona. Mitteil. Deuts. Dendr. Gesells. **13**: 46–52. *pl. 2–6.* 1904.

Rehder, A. [Silberlinden.] Mitteil. Deuts. Dendr. Gesells. **13**: 208–210. 1904.

Rehm, H. *Ascomycetes* exs. fasc. 33. Ann. Myc. **2**: 515–521. 10 D 1904.

Includes descriptions of *Gibberidea obducens* Rick and *Apiosporium Rehmii* Sydow, two new species from Brazil.

Rehm, H. Revision der Gattungen *Tryblidiella* Sacc., *Rhydithysterium* Speg., *Tryblidaria* Sacc., *Tryblidium* Rebent., *Tryblidiopsis* Karst. Ann. Myc. **2**: 522–526. 10 D 1904.

With many new combinations.

Reiche, K. Bau und Leben der chilenischen Loranthacee *Phrygilanthus aphyllus*. Flora **93**: 271–297. *pl. 5 + f. 1–9.* 10 Au 1904.

Rolfe, R. A. *Cattleya Loddigesii* and *C. Harrisoniana*. Orchid Rev. **12**: 353–356. D 1904.

Natives of South America.

Rolfe, R. A. *Stanhopea anfracta*. Orchid Rev. **12**: 357. D 1904.

Native of Colombia.

Rothrock, J. T. Black ash. (*Fraxinus sambucifolia* Lam.) (*Fraxinus nigra* Marsh.) Forest Leaves **10**: 184, 185. D 1904. [Illust.]

Schumann, K., & Gürke, M. Blühende Kakteen (Iconographia *Cactacearum*). 13: *pl. 49–52b.* 1 Au 1904; 14: *pl. 53–56.*

Shaw, G. R. The Pines of Cuba. Gard. Chron. III. **35**: 179, 180. *f. 74.* 19 Mr 1904.

Shreve, F. Some plants which entrap insects. Pop. Sci. Mo. **65**: 417–431. *f. 1–11.* S 1904.

Smith, C. P. Report upon a botanical survey of the Indiana State Forest Reservation. Ann. Rep. State Board Forestry Ind. **3**: 73–159. *pl. 1–43 + map.* 1904.

Spillman, W. J. Hybrid wheats. Science II. **20**: 681. 18 N 1904.

Stephani, F. Species *Hepaticarum.* Bull. Herb. Boiss. II. **4**: 973–988. 30 S 1904; 1197–1214. 5 D 1904.

Devoted chiefly to South American species, including 6 described as new.

Sterling, E. A. Chaparral in northern California. Forestry Quart. **2**: 209–214. N 1904.

Tracy, W. W. American varieties of lettuce. U. S. Dept. Agr. Plant Ind. Bull. **69**: 1–103. *pl. 1–27.* 23 D 1904.

Trotter, A. Notulae mycologicae. Ann. Myc. **2**: 533–538. *f. 1–4.* 10 D 1904.

Includes *Uromyces brasiliensis* nom. nov. (*U. giganteus* Dietel non Speg.)

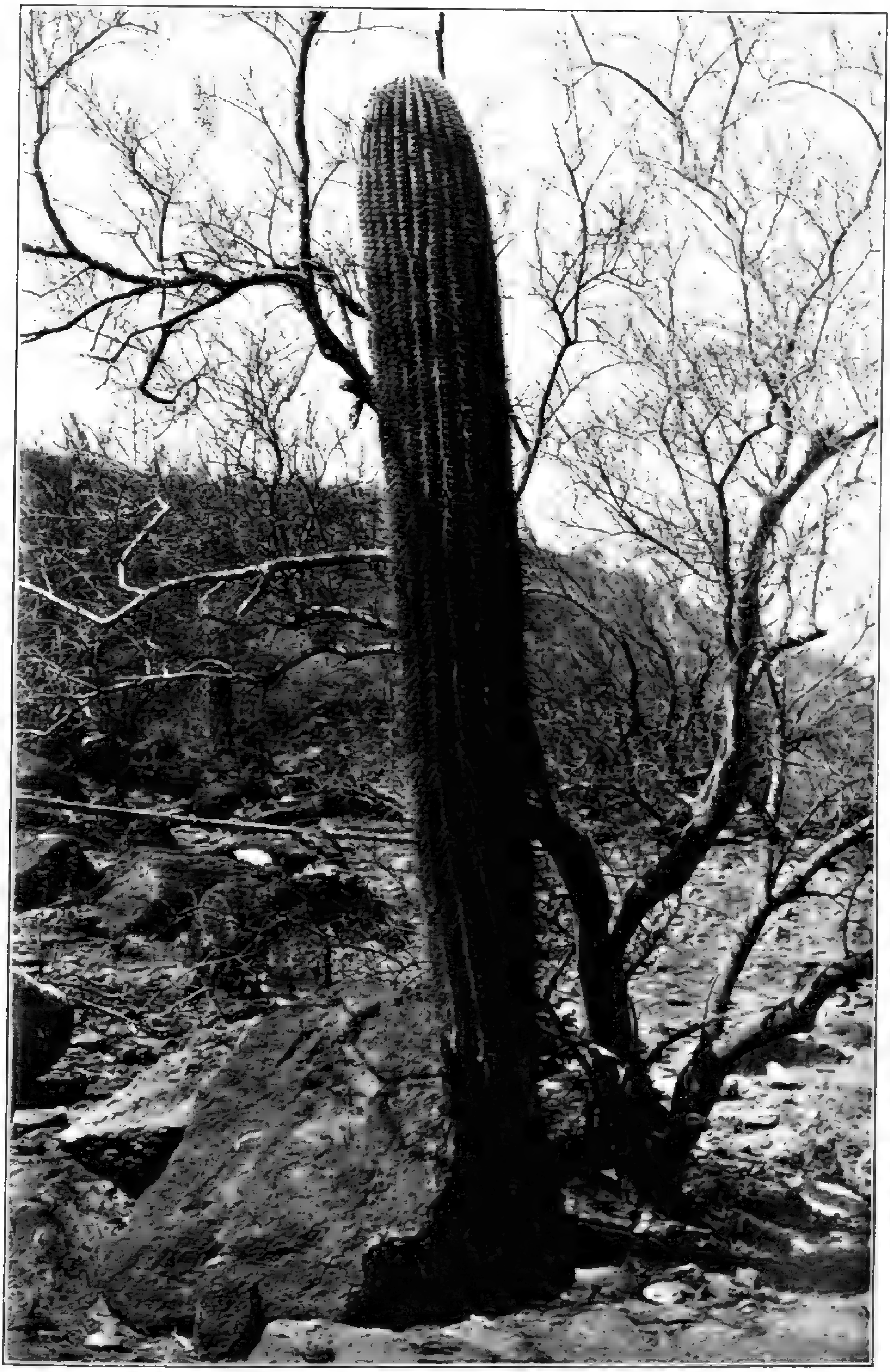
Van Tieghem, P. Structure de la tige des Calycanthacées. Bull. Mus. Hist. Nat. Paris **10**: 68–78. 1904.

Van Tieghem, P. Sur le genre Wallacée, considéré comme type d'une famille nouvelle, les Wallacéacées. Bull. Mus. Hist. Nat. Paris **10**: 145–150. 1904.

Ward, M. E. *Mimulus moschatus* in Massachusetts. Rhodora **6**: 227, 228. 30 N 1904.

Weber, A. Oeuvres posthumes. Bull. Mus. Hist. Nat. Paris **10**: 382–399. 1904.

Includes descriptions of new species and varieties in *Mamillaria*, *Cereus* (5), *Pilocereus*, *Echinopsis*, *Echinocactus* and *Opuntia* (8).



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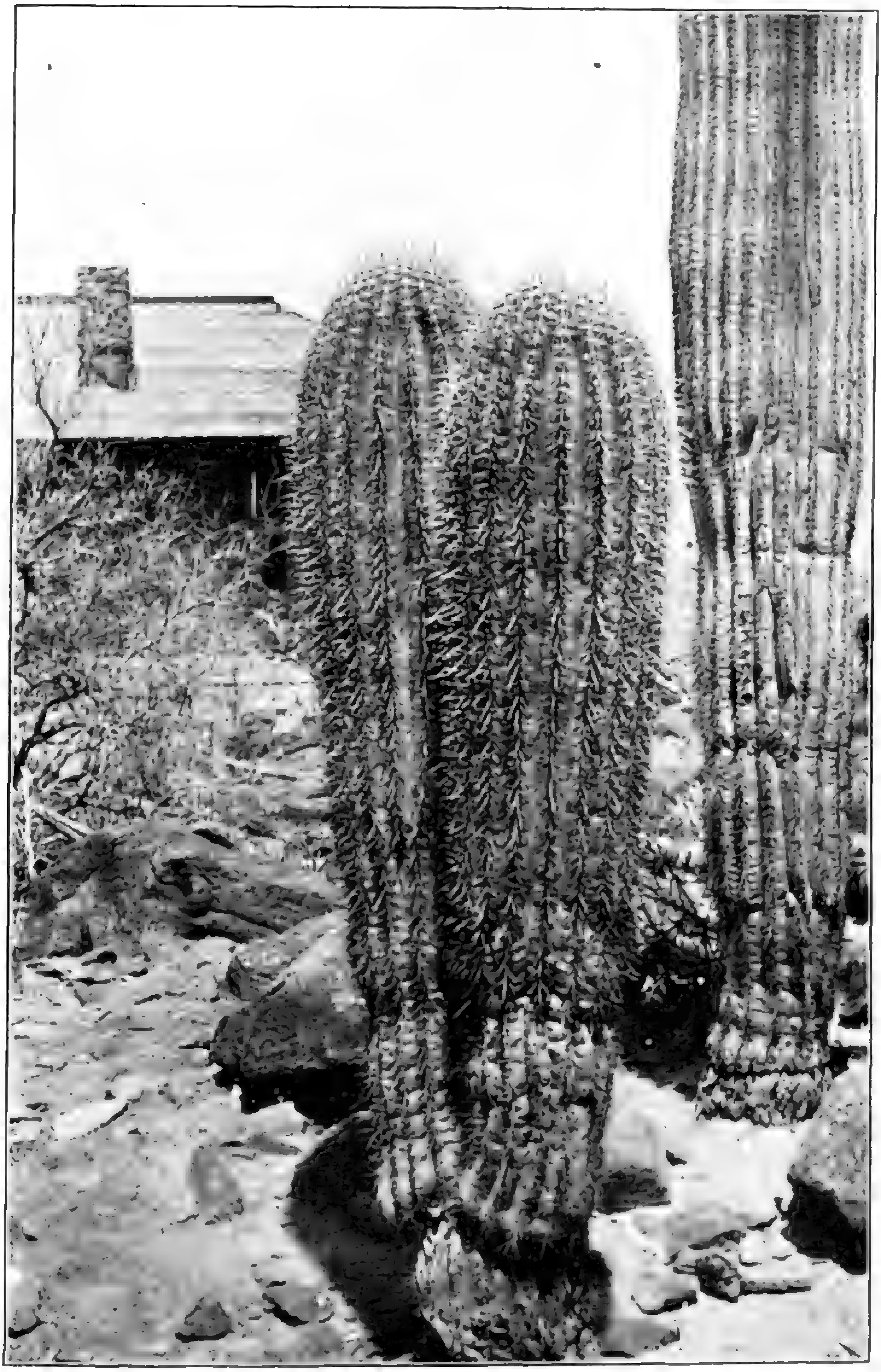

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BULLETIN

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TORREY BOTANICAL CLUB

MARCH, 1905

Studies on the Rocky Mountain flora — XIV

PER AXEL RYDBERG

Machaeranthera Fremontii sp. nov.

Biennial with thick taproot; stems several, glandular-hispid and somewhat puberulent, 4–5 dm. high, branched; basal leaves oblanceolate, petioled, glandular-hispid and scabrous, sharply dentate; upper leaves sessile, linear or lanceolate; heads over 1 cm. high; bracts linear-lanceolate, cinereous, acuminate, well imbricated; herbaceous tip short, lanceolate, only slightly squarrose; rays purple, 8–10 mm. long; achenes densely strigose; pappus brownish or reddish.

It grows in black soil of river bottoms.

COLORADO: "Platte Waters," 1844, *Fremont 421* (type in herb. Columbia Univ.).

Machaeranthera Selbyi sp. nov.

Biennial; stem reddish, branched above, glabrous below, puberulent or minutely strigose above, only slightly glandular in the inflorescence; lower leaves linear-oblanceolate to oblanceolate, petioled, glabrous or rarely slightly puberulent, dentate and ciliate on the margin; upper leaves linear; inflorescence branched and open; heads about 1 cm. high; bracts in many series, well imbricated; glandular green tips small, lanceolate, strongly reflexed-squarrose; achenes minutely strigose.

This is perhaps nearest related to *M. spectabilis*, but that species has entire leaves and longer green tips to the bracts. It is also related to *M. glabrella* and *M. ramosa*, from which species it differs in the reflexed-squarrose bracts.

COLORADO: Ouray, 1901, *Underwood & Selby 93a* (type), *204*, *204s*, *201* and *202*.

[The BULLETIN for February (32: 57–122, *pl. 3. 4*) was issued 22 Mr 1905.]

Machaeranthera viscosula sp. nov.

Biennial with a rosette of basal leaves; stems few, about 2 dm. high, viscid-puberulent; basal leaves oblanceolate, petioled, the upper similar or linear, but sessile; all saliently and coarsely toothed; inflorescence narrow and racemiform, very viscid; heads about 1 cm. high; bracts linear, with a long linear-subulate spreading or reflexed green and very glandular tip, usually longer than the chartaceous lower portion; rays reddish-purple, 8–10 mm. long and fully 1 mm. wide; achenes sparingly strigose; pappus tawny.

This is closely related to *M. viscosa*, but differs in the lower stature, the racemiform inflorescence and the narrow saliently toothed basal leaves.

COLORADO: Veta Pass, 1896, *Shear 3655;* South Park, southeast of Jefferson, 1896, *Cowen 3222.*

Xylorrhiza Brandegei sp. nov.

Perennial with a cespitose caudex, canescent throughout, almost 1 dm. high; leaves spatulate or the upper oblanceolate, 3–4 cm. long, firm, closely and sharply serrate with bristle-tipped teeth; disk about 3 cm. wide; bracts narrowly linear-lanceolate, attenuate; achenes oblong, densely grayish-strigose, pappus tawny; rays rose-purple, 15–20 mm. long.

Closely related to **X. coloradensis** (*Aster coloradensis* Gray), but differs in the larger size, longer rays and scarcely spinescent bracts. It grows at an altitude of 3000 m.

COLORADO: San Juan Pass, 1875, *Brandegee* (type in the Gray herbarium).

Erigeron nematophyllus sp. nov.

Depressed cespitose-pulvinate perennial; flowering stems several, strigose, about 5 cm. high, few-leaved; both basal and cauline leaves linear-filiform, 2–4 cm. long, less than 1 mm. wide, strigose; heads solitary, 4–5 mm. high; bracts linear in 1–2 series, scarcely at all imbricated, acute, hirsute-strigose; rays pinkish or white, 4–5 mm. long and 1 mm. wide; achenes sparingly hirsute.

This is closely related to *E. radicatus*, but differs in the very narrow and erect leaves. It grows on rocky hills.

COLORADO: Dale Creek, 1897, *Osterhout* (type).

WYOMING: Fort Steele, 1901, *Tweedy 4103;* Sand Creek, 1900, *Aven Nelson 6993.*

Erigeron salicinus sp. nov.

Perennial with a slender rootstock; stem simple, 4–7 dm. high, glabrous or minutely and sparingly strigulose above; lower leaves petioled, about 1 dm. long; blades oblanceolate, dark bluish-green, glabrous except the minutely ciliolate entire margins, more or less distinctly 3-nerved; upper leaves linear or linear-lanceolate, sessile and half-clasping; inflorescence corymbiform, leafy; heads 7–8 mm. high; bracts linear-subulate, acuminate, glandular-puberulent, not at all hirsute, in 2 series but almost equal and crowded; disk 12–15 mm. wide; rays very numerous, fully 1 cm. long and less than 1 mm. wide, purple.

This is perhaps nearest related to *E. macranthus*, differing in the bluish-green narrow leaves, which are minutely ciliolate on the margin instead of hirsute-ciliate, and in the smaller heads.

COLORADO: Pagosa Springs, 1899, *Baker 670.*

Erigeron Vreelandii sp. nov.

Perennial with a rootstock; stem 6–7 dm. high, simple, sparingly pubescent and puberulent; lower leaves petioled, their blades oblanceolate; the rest sessile, lanceolate, somewhat clasping, entire, glandular-puberulent on both sides; inflorescence leafy, corymbiform; heads fully 1 cm. high; bracts linear-subulate, hirsute and glandular-puberulent, in 2 series, almost equal; disk 15–18 mm. wide; rays fully 1 cm. long, less than 1 mm. wide, very numerous, dark-purple.

This is nearest related to *E. subtrinervis*, but the leaves are glandular-puberulent instead of hirsute. It grows in meadows at an altitude of about 2300 m.

COLORADO: Wahatoya Creek, 1900, *Rydberg & Vreeland 5414.*

Erigeron Smithii sp. nov.

Perennial with a rootstock; stem simple, glabrous below, glandular-puberulent above; basal leaves 6–10 cm. long, petioled; blades oblanceolate or spatulate, glabrous, ciliate on the entire margins; upper stem-leaves lanceolate, sessile, more or less clasping and often reduced; heads 1–5, on long almost erect branches, about 6 mm. high; bracts linear-subulate, acuminate, glandular-puberulent, in two equal series; rays purple, 10–12 mm. long, 1 mm. wide; achenes strigose; pappus double, the outer of very short bristles.

This is closely related to *E. glabellus*, but is more glabrous, and has glandular-puberulent, not hirsute, bracts. It grows in rich meadows at an altitude of 2100–3000 m.

COLORADO: Parlin, Gunnison Co., '1901, *B. H. Smith 118* (type); Gunnison, 1901, *Baker 558;* Antonito, 1898, *Earle 42;* Sargent, 1896, *Clements 127;* Villa Grove, 1896, *Clements 123;* Leadville, 1901, *Underwood & Selby 494.*

Erigeron Earlei sp. nov.

Perennial; stems several, simple, 3–4 dm. high, strigose; basal leaves 5–6 cm. long, narrowly oblanceolate, strigose on both sides, often callous-denticulate; stem-leaves linear and sessile, and reduced; heads about 3, 6 mm. high; bracts linear-subulate, acuminate, in about 2 series, nearly equal, densely strigose; rays numerous and very narrow, white, about 8 mm. long.

This is related to *E. glabellus*, but differs from all its relatives by the appressed, dense, strigose pubescence.

COLORADO: Antonito, 1898, *Earle.*

Erigeron Peasei sp. nov.

Depressed cestipose perennial; stem 5–8 cm. high, scapiform or with 1–2 leaves, appressed-pubescent; basal leaves about 2 cm. long, petioled, their blades oblanceolate, acute, strigose; stem-leaves linear, sessile; heads solitary, 6–7 mm. high; bracts linear-subulate, scarcely at all imbricated, acuminate, sparingly hirsute; disk about 1 cm. wide; rays numerous, about 7 mm. long and 1 mm. wide.

This is nearly related to *E. radicatus*, but differs in the appressed pubescence and broader leaves.

COLORADO: Lake City, 1878, *H. N. Pease* (type in herb. Columbia Univ.).

Erigeron vetensis sp. nov.

Densely cespitose-puvinate perennial; stems 5–8 cm. high, hirsute, few-leaved; leaves linear or linear-oblanceolate, hirsute, 2–4 cm. long; heads solitary, about 7 mm. high; bracts linear, acuminate, hirsute as well as slightly glandular-puberulent; rays purple, 8–10 mm. long, over 1 mm. wide; achenes strigose; pappus more or less double.

In dry places on high mountains of southern Colorado at an altitude of 2400–3000 m. It is intermediate between *E. radicatus* and *E. glandulosus*, resembling the former most in pubescence, and the latter in habit.

COLORADO: Mountains near Veta Pass, 1900, *Rydberg & Vreeland 5427* (type); Veta Mountain and Ojo, *5421, 5422;* West Spanish Peak, *5424.*

Antennaria Sierrae-Blancae sp. nov.

Depressed perennial, pulvinate-cespitose, rosulate, almost stemless; leaves broadly spatulate, less than 1 cm. long, abruptly acute, white-floccose beneath, glabrate above; heads subsessile in the rosettes, 6–7 mm. in diameter; bracts broadly oblong to almost obovate, with a scarious brown upper portion.

Closely resembling *A. rosulata* in habit, it differs however in the smaller heads, brown bracts and leaves that are glabrate above. It grows at an altitude of 3600–4000 m.

COLORADO: Sierra Blanca, 1877, *Hooker & Gray* (type in Gray herbarium).

Helianthus aridus sp. nov.

Annual; stem 3–8 dm. high, more or less hispid; leaves all petioled, the lower opposite, the upper usually alternate; blades lanceolate, 4–7 cm. long, entire or crenate, acute, hispid-scabrous on both sides; heads rather few; bracts ovate, abruptly acuminate, hispid on the back and hispid-ciliate on the margins; disk 1.5–2 cm. wide, purplish; rays oblong to oval, 15–20 mm. long, 6–8 mm. wide; achenes cuneate, almost black, finely strigose, about 5 mm. long and 2 mm. wide.

This species has been mistaken for *H. petiolaris*, which it resembles most, but the bracts are hispid-ciliate and strongly acuminate in the manner of *H. lenticularis*. *H. aridus* grows in dry ground, especially in old fields and waste places.

MONTANA: Great Falls, 1885, *F. W. Anderson* (type); Polson, 1901, *Umbach 261.*

WYOMING: Gros Ventre Mountains, 1900, *C. C. Curtis.*

COLORADO: Manitou, 1901, *Clements 8* (mixed with *H. petiolaris*).

NEBRASKA: Kimball, 1891, *Rydberg 184.*

Tetraneuris Crandallii sp. nov.

Cespitose, acaulescent perennial; leaves narrowly linear-oblanceolate, conspicuously white-woolly at the base, 4–6 cm. long, 2–3 mm. wide, sparingly long-hairy, soon glabrate; scape 1–3 dm. long, sparingly strigose; involucre hemispherical; bracts about 8 mm. long, linear-oblong, silky-villous, but hairs rather appressed; rays about 15 mm. long, 5–8 mm. wide, 3-lobed, 4–5-nerved.

This species is related to *T. arizonica* and *T. pilosa*, but differs from the first in the narrow glabrate leaves, and from the latter in the narrow bracts and larger rays.

COLORADO: Grand Junction, 1894, *Crandall* (type); McCoy's, Eagle County, *Osterhout 2757*.

Tetraneuris angustifolia sp. nov.

Cespitose, acaulescent perennial; leaves narrowly linear-oblanceolate, 4–10 cm. long, 4–5 mm. wide, loosely and sparingly long-villous or glabrate in age, not densely villous at the base; scape 2–3 dm. high, strigose; involucre hemispherical; bracts oblong, obtuse, densely villous; disk 10–12 mm. wide; rays about 1 cm. long and 4 mm. wide, 3-toothed and conspicuously 4-nerved.

This species is nearest related to *T. scaposa*, from which it differs in the narrow leaves. It has therefore been mistaken for *T. linearis*; but in that species the branches of the caudex are rather slender and elongated and the leaves are narrowly linear, 1–2 mm. wide. *T. angustifolia* grows on rocky hills up to an altitude of 2000 m.

NEW MEXICO: White Mountains, 1897, *Wooton 374* (type).

COLORADO: Fort Lyon, 1863, *Palmer*.

TEXAS: Kerrville, 1894, *Heller 1614*; Great Cañon of Mt. Carmel, 1852, *Parry* (Mex. Bound.) *638*; Belknap, 1858, *Hayes*; Rock Creek and Limpia, 1852, *Bigelow* (Mex. Bound); Rio Bravo del Norte, between San Pedro and Puercos, 1852, *Schott*.

Artemisia dracunculoides Wolfii var. nov.

Stout, usually with broader leaf-segments or leaves; heads larger, 3–5.5 mm. in diameter; outer bracts longer, lanceolate or linear-oblong, mostly acutish, nearly equaling the inner (in *A. dracunculoides* oblong, obtuse, about half as long as the inner).

COLORADO: Twin Lakes, 1873, *Wolf 530* (type); Hamor's Lake, north of Durango, 1898, *Baker, Earle & Tracy 628*; Grizzly Creek, 1896, *Baker*.

NEW MEXICO: Chama, 1899, *Baker 631*.

Artemisia saxicola nom. nov.

Artemisia Chamissoniana saxatilis Besser; Hook. Fl. Bor. Am. 1: 324. 1833. Not *A. saxatilis* Waldst.

A. norvegica A. Gray. Syn. Fl. 1^2: 371. 1884. Not *A. norvegica* Fries.

The American plant differs from the North European in having more numerous smaller heads on shorter peduncles, more hairy leaves, lanceolate in outline, and taller stem. In the true *A. norvegica* the basal leaf-blades are as broad as long and have usually only 5 principal divisions.

Artemisia Brittonii sp. nov.

Perennial with a horizontal rootstock; stem rather stout, 3–6 dm. high, white-floccose; lower leaves cuneate or oblong-oblanceolate, 3–5-lobed mostly above the middle, densely white-tomentose on both sides, the lobes lanceolate; upper leaves ovate-lanceolate, entire; inflorescence paniculate; panicles narrow and heads conglomerate, 3–4 mm. high, about 2 mm. broad; bracts ovate and densely floccose; flowers about 15, heterogamous, light-brown or yellow; achenes and receptacle glabrous.

This is related to *A. ludoviciana* Nutt., but differing in the stouter habit, more crowded inflorescence, and principally in the leaves, which are equally tomentose on both sides.

COLORADO: Golden, 1882, *N. L. Britton* (type, in herb. Columbia College); Boulder, 1891, *Penard 285;* also 1902, *Tweedy 4906.*

UTAH: Green River, 1850, *Stansbury;* Salt Lake Valley, *Lauderdale;* Salt Lake City, 1884, *Harry Edwards.*

Artemisia Underwoodii sp. nov.

Perennial, with a horizontal much-branched rootstock; stems slender, 2–6 dm. high. somewhat floccose, usually simple up to the inflorescence; leaves 3–5 cm. long, pinnately parted, with 3–7 (usually 5) linear or linear-lanceolate acute lobes, densely white-floccose beneath, green and slightly tomentose above at first, but in age glabrate; inflorescence paniculate, but panicle narrow and the small heads crowded; heads campanulate, scarcely over 3 mm. high and 2.5 mm. broad; bracts ovate, tomentose, slightly scarious on the margin; flowers 15–20, heterogamous, brown; achenes and receptacle glabrous.

This is nearest related to *A. ludoviciana*, but differs in the deeply parted leaves and their narrow lobes. It grows on chaparral-covered hills and mountain-sides at an altitude of 2300–2700 m.

COLORADO: Ouray, 1901, *Underwood & Selby 74* (type) and *34;* Georgetown, 1895, *Rydberg.*

√ **Artemisia pudica** sp. nov.

Perennial with a horizontal rootstock; stem 4–6 dm. high, simple up to the inflorescence, white-floccose; leaves linear or narrowly linear-lanceolate, 6–10 cm. long, 6–8 mm. wide, entire, white-floccose on both sides; inflorescence a narrow panicle, the branches long and nearly erect, racemiform; heads nodding on short peduncles, campanulate, about 5 mm. high and 4 mm. broad; bracts ovate, densely tomentose, with a darker midrib and slightly scarious margin; flowers about 20, heterogamous, yellow; receptacle and achenes glabrous.

This species is related to *A. gnaplalodes*, but is characterized by the racemiform branches of the inflorescence with peduncled, nodding heads. It grows at an altitude of about 2300 m.

COLORADO: Gunnison, 1901, *Baker 573*.

√ **Pyrrocoma lagopus** sp. nov.

Perennial with a taproot; stems decumbent, 1–2 dm. long, more or less villous, especially at the base and the nodes; basal leaves petioled, 6–10 cm. long; blades lanceolate or linear-lanceolate, firm, distantly serrate with almost spinulose teeth; stem-leaves narrowly linear-lanceolate, sessile, with partly clasping bases; inflorescence racemiform; involucre 8–9 mm. high, more or less villous, especially at the base; bracts imbricated in about 3 series, oblong, acute, green on the back, yellowish on the sides and base; disk about 12 cm. wide; rays about 8 mm. long and over 1 mm. wide; achenes hirsute-strigose.

This species is nearest related to *P. Vaseyi*, but differs in the villous stem and involucre. In habit it also reminds one of *P. uniflora* and *P. inuloides*, but in these species the bracts are nearly in a single equal series. *P. lagopus* grows on dry plains and in saline flats.

WYOMING: Hams Fork and La Barge, 1900, *C. C. Curtis* (type).

COLORADO: North Park, 1899 (collector not given, but plants distributed from Herb. State Agr. Coll., under no. *3232*).

√ **Tetradymia linearis** sp. nov.

A low, unarmed shrub; bark of the older stems shining and flaky, that of the young branches more or less white tomentulose; leaves linear, white-tomentose, somewhat keeled, more or less arcuate-squarrose and pungent-pointed; bracts of the involucre usually 4, oblong, acute, white-tomentose, about 8 mm. long; flowers about 4; lobes of the corolla linear, about 3 mm. long; pappus very copious, yellowish; bristles scabrous; achenes hirsute-villous.

This species grows on dry hills and tablelands up to an altitude of 2300 m. It is nearest related to *T. inermis* Nutt., but is distinguished by the narrow, more or less squarrose, and pungent leaves.

UTAH: Rock Creek, 1877, *Palmer 264* (type, in herb. Columbia University).

COLORADO: Gunnison, 1901, *Baker 833*.

Arnica coloradensis sp. nov.

Perennial, about 2 dm. high and with about 3 pairs of leaves; stem villous; basal leaves obovate, nearly sessile, sparingly pubescent, 4–5 cm. long; stem-leaves sessile, ovate or ovate-lanceolate, 5-nerved; heads often solitary or few; involucre hemispherical; bracts broadly oblanceolate, acute or acuminate, often tinged with purple, sparingly villous and somewhat glandular, 8–9 mm. long; rays bright-yellow, over 1 cm. long and 5 mm. wide; achenes finely strigose.

This species is perhaps nearest related to *A. subplumosa*, but differs in the low habit, the single or few heads, and the broad involucral bracts.

COLORADO: 1872, *Parry* (in herb. Columbia University).

Carduus Osterhoutii sp. nov.

Stout; stem round-angled and striate, more or less tinged with purple, more or less arachnoid-hairy; leaves pinnately parted about halfway to the midrib, glabrate above, white-tomentose beneath; lobes at least of the larger leaves oblong, obtuse with a weak spine; heads 2.5–3 cm. high and about 2 cm. broad; bracts arachnoid-hairy, linear-lanceolate, without glandular dorsal ridge, gradually tapering into an almost erect, stout, flat spine; pappus scabrous.

This is nearest related to *C. Hookerianus* and *C. oreophilus*, but differs from both in the oblong, obtuse lobes of the larger leaves and the long, stout, flat spines of the involucre.

COLORADO: Red Cliff, Eagle Co., 1902, *Osterhout 2706* (type); Tennessee Pass, *2640*.

Carduus perplexans sp. nov.

Rather slender, about 5 dm. high; stem striate, purplish, slightly tomentose; lower leaves oblanceolate, the upper lanceolate and clasping, all merely toothed, with weak yellowish spines, glabrous and somewhat glaucous above, rather thinly white-tomentose beneath; heads about 3 cm. high and broad; bracts well imbricated, usually with a glandular back, the outer shorter and tipped with a short weak spine, the inner tipped with a dilated, deltoid, erose appendage; corolla rose or red-purple.

The appendages of the bracts would place this species nearest *C. Centaureae*, but the bracts are broader and have a distinct glandular back, the corolla is pink or purplish, and the whole plant suggests *C. altissimus* and its relatives. In fact the species combines characters of the *Carlinoides* and the *Altissimus* groups. It grows at an altitude of nearly 2100 m.

COLORADO: Cimarron, 1901, *Baker 286.*

Carduus coloradensis sp. nov.

Cnicus Drummondii A. Gray Syn. Fl. 1^2: 402, in part, *i. e.*, as to the Colorado specimens.

Rather stout, simple, 3–5 dm. high; stem striate, sparingly arachnoid; leaves 1.5–2 dm. long, 4–7 cm. wide, linear or oblong in outline, pinnately lobed about half-way to the midrib, sparingly arachnoid above, more or less white-tomentose beneath; lobes ovate, tipped with yellowish spines 2–5 mm. long and bordered with smaller spines; heads 3–4 cm. high and about as broad; bracts glabrous or nearly so, firm, more or less yellowish, without dorsal glandular ridge, well imbricated in many unequal series; the outer with weak spines; the inner unarmed and with slightly dilated crisp tips; corolla white or slightly pinkish.

This species has gone under the name of *C. Drummondii*, but the latter has larger heads often 5 cm. high and broad, broader and thin flat brownish or greenish bracts, broader erose appendages, red-purple corolla, and the leaves more deeply dissected, more arachnoid and scarcely at all tomentose. In reality *C. coloradensis* is more closely related to *C. scariosus*, from which it differs mainly in the less deeply dissected leaves and broader segments.

COLORADO: Pagosa Springs, 1899, *Baker 644* (type); Gunnison, 1901, *Baker 592;* Wolcott, 1902, *Osterhout 2651.*

Carduus floccosus sp. nov.

Stout, about 1 m. high; stem angled, loosely floccose; leaves oblanceolate in outline, about 2 dm. long, loosely floccose on both sides, divided two-thirds to the midrib; lobes 2-cleft, each division lanceolate, 1.5-2 cm. long, tipped with a spine about 5 mm. long; heads about 3 cm. high, 1.5–2.5 cm. wide; bracts slightly floccose on the margin and with a very narrow glandular dorsal line; the outer lanceolate, the inner linear-lanceolate, all with a short and weak spine; corolla red-purple.

This species belongs to the *C. undulatus* group and has been mistaken for that species. It has almost the same kind of leaves, although more loosely floccose; but the heads are very different, resembling more those of *C. Flodmanii* and *C. altissimus*, the bracts having a very slender glandular dorsal line.

COLORADO: Wolcott, 1902, *Osterhout 2652*.

Carduus Tracyi sp. nov.

Simple below; stem 3–7 dm. high, striate and loosely floccose; leaves oblanceolate in outline, divided to near the base, green but slightly floccose above, more or less tomentose beneath; lobes oblong to linear-lanceolate, tipped with yellow spines 5–8 mm. long; heads 3–3.5 cm. high and about 3 cm. or less wide; bracts slightly floccose when young, yellowish with a very broad and dark glandular spot on the back, the outermost and inner narrowly lanceolate, the middle ovate-lanceolate, all with a short spreading spine; corolla ochroleucous.

This is nearest related to *C. Nelsonii* Pammel, but is less tomentose, has smaller heads, more acute leaf-segments, and broader bracts with shorter, more slender and spreading spines. It grows in dry fields at an altitude of about 2100 m.

COLORADO: Mancos, 1898, *Baker, Earle & Tracy 90* (type); Green Mountain Falls, 1895, *E. A. Bessey*.

Gaertneria linearis sp. nov.

Perennial, shrubby at base; stems about 2 dm. high, sparingly hirsute, branched; leaves once or twice pinnate, 3–4 cm. long, strigose above, minutely tomentulose beneath; lobes linear, obtuse, 3–5 mm. long; staminate racemes about 3 cm. long; heads nodding, 3–4 mm. wide; involucre strigose, cleft scarcely halfways into rounded-ovate lobes; pistillate involucre with few slender spines.

This is perhaps nearest related to *G. tenuifolia*, but is shrubby at base; the leaves are smaller, finely tomentulose beneath and with linear obtuse (instead of oblong acute) divisions, of which the terminal is not conspicuously elongated. *G. linearis* grows at an altitude of 2100 m.

COLORADO: Calhan, 1893, *Saunders*.

Crepis tomentulosa sp. nov.

Scapose perennial, with a taproot; leaves basal, glabrous and glaucous, 1–1.5 dm. long, oblanceolate in outline, acute, sessile, dentate with sharp salient or reflexed teeth; scape 4–5 dm. high; stem-leaves, if any, linear-lanceolate, bract-like, entire; involucre turbinate, about 12 mm. high, as well as the upper part of the branches of the inflorescence tomentulose when young; bracts linear-lanceolate, acuminate, with dark backs, and with a few calyc-culate ones at their base; ligules bright-yellow, nearly 1 cm. long.

This species is nearest related to *C. glauca*, from which it differs principally in the tomentulose involucre and peduncles. It grows at an altitude of nearly 3000 m.

COLORADO: Ruxton Dell, near Pikes Peak, 1901, *Clements 342*.

Crepis petiolata sp. nov.

Perennial; stem with 1–3 leaves, glabrous and often purplish below, more or less glandular-hirsute above, especially the branches of the inflorescence; basal leaves long-petioled; blades oblanceolate or spatulate, usually obtuse, sinuate-dentate or entire, about 1 dm. long, glabrous and glaucous; stem-leaves oblanceolate and usually sessile; involucre about 12 mm. high, turbinate-campanulate, pubescent with glandular black hairs; bracts linear-lanceolate, acuminate; ligules about 12 mm. long and 3 mm. wide; achenes strongly ribbed; pappus white.

This species is related to *C. runcinata*, but the leaves are glabrous and long-petioled, and the stem-leaves are usually ample. It grows in the mountains at an altitude of 2000–2700 m.

COLORADO: Along Bear River, five miles east of Hayden, 1899, *Osterhout 21* (type); Georgetown, 1895, *Rydberg*.

WYOMING: Headwaters of Clear Creek and Crazy Woman River, 1900, *Tweedy 3088*.

Crepis perplexans sp. nov.

A scapose perennial; leaves about 1 dm. long, glaucous and glabrous or rarely with a few hairs on the midrib below and on the margin of the narrower base, oblanceolate, sessile or short-petioled, usually more or less runcinate-toothed; scape glabrous; involucres turbinate-campanulate, about 1 cm. high, more or less glandular-hairy with yellowish hairs and slightly tomentulose when young; bracts linear-lanceolate, acuminate; rays yellow, about 1 cm. long; achenes brown, strongly ribbed; pappus white.

This has been confused with *C. runcinata*, but that species has thinner hairy leaves, which are scarcely glaucous. *C. confusa* is really more closely related to *C. glauca*, from which it differs only in the pubescence of the involucre and the usually broader leaves. *C. confusa* grows in valleys from North Dakota and Alberta to Nebraska and Colorado. As the type may be regarded:

WYOMING: Encampment, Carbon Co., 1901, *Tweedy 4081*.

Crepis denticulata sp. nov.

Scapose perennial; leaves basal, obovate or more rarely obovate-oblanceolate, glabrous or nearly so, obtuse, less than 1 cm. long, denticulate or with a few lobes towards the base; scape 1–3 dm. high, glabrous up to the inflorescence; involucre turbinate, scarcely 1 cm. high, hirsute with glandular black hairs, as well as the branches of the inflorescence; ligules about 8 mm. long; achenes brown, strongly ribbed; pappus white.

This species is nearest related to *C. riparia*, but is a much smaller plant in every part and with glabrous leaves. It grows in the mountains.

COLORADO: Lake John, North Park, 1898, *Shear & Bessey 4004* (type).

WYOMING: Fort Bridger, 1873, *Porter*.

UTAH: 1875, *Parry 62;* Jordan Valley, 1869, *Watson 712*.

Crepis angustata sp. nov.

Crepis gracilis Rydb. Mem. N. Y. Bot. Gard. **1**: 461, in part. 1900. Not *C. occidentalis gracilis* D. C. Eaton.

Perennial, whole plant more or less canescent-puberulent and scabrous; stem 3–7 dm. high; basal leaves and lower stem-leaves petioled, runcinate; main body narrowly linear-lanceolate, acuminate; lobes linear or linear-lanceolate, usually curved forward; upper stem-leaves entire and sessile; involucre cylindric, about 1 cm. high and 5 mm. broad; bracts 5–7, linear-lanceolate, acute, canescent but not glandular, with a few minute calyculate ones below; flowers 5–10.

This species has been taken for *C. gracilis*, or *C. intermedia gracilis*, under which name it is more commonly known, but the latter has much narrower leaves, the main portion not being wider than the long lobes. *C. intermedia*, to which it is more closely related, has much broader main portion of the leaves, and the lobes are lanceolate and usually directed downward. *C. angustata* grow on hillsides from Montana and Washington to Colorado and Oregon.

COLORADO: North Park, 1896, *Baker* (type).

Agoseris maculata sp. nov.

Leaves oblanceolate, more or less pubescent, especially on the margins and veins; scape 1–2 dm. high, often sparingly hairy and villous under the head; involucre campanulate, about 2 cm. high; outer bracts ovate or ovate-lanceolate, more or less villous especially on the margins, dotted with blackish dots; inner bracts lanceolate; ligules yellow or the outer tinged with reddish; achenes with a short striate beak.

This is somewhat related to *A. villosa*, but differs in the broad acuminate outer bracts. It grows in the mountains of Colorado at an altitude of 3000–3900 m.

COLORADO: Silver Plume, 1895, *Shear 4605* (type); Tennessee Pass, 1902, *Osterhout 2643*.

Agoseris attenuata sp. nov.

Leaves narrowly oblanceolate, 1–1.5 dm. long, glabrous and glaucous, usually denticulate, tapering into a short petiole; scape about 1.5 dm. high, villous near the head; involucre campanulate, about 2 cm. high; outer bracts lanceolate, somewhat villous on the margins, purplish on the back; inner bracts linear-lanceolate long-attenuate, equaling the pappus; achenes light-brown, with thick ribs, contracted above into a short striate beak.

This is related to *A. pumila* and *A. glauca*, but differs from the former in the smaller heads and narrower leaves, from the latter in the more or less villous involucre, and from both in the elongated inner bracts. It grows at an altitude of nearly 3000 m.

COLORADO: Mountain west of North Park, 1900, *Osterhout 2248*.

Agoseris roseata sp. nov.

Leaves about 2 dm. long, long-petioled; blades oblanceolate, acute, denticulate or entire, glabrous and glaucous; scape 5–6 dm.

high, slightly villous above; involucre campanulate, 1.5–2 cm. high; bracts oblong-ovate, acute, nearly glabrous, often with a rose-colored spot in the middle; corolla rose-colored; achenes about 1 cm. long, as well as the short beak strongly striate.

In habit and flowers this resembles most *A. aurantiaca*, but is glabrous and glaucous, and the achene with its short beak places it in the *A. glauca* group.

COLORADO: Bear River, 20 miles below Steamboat Springs, 1899, *Osterhout.*

Agoseris humilis sp. nov.

Leaves spreading or ascending, oblanceolate or linear-oblanceolate, 6–10 cm. long, entire or denticulate, glabrous or slightly hairy on the short petioles; scape 1–1.5 (seldom 2) cm. high, slightly villous below the head; involucre 1.5–2 cm. high; bracts linear-lanceolate, slightly villous-ciliate; corolla rose-purple, or at first orange; achenes 12–15 mm. long, with a long, scarcely striate beak.

This is closely related to *A. gracilens*, but differs in the low habit, small heads and more spreading leaves. It grows at an altitude of about 2700 m.

COLORADO: Ironton Park, 1901, *Underwood & Selby 308* (type); Tennessee Pass, 1902, *Osterhout 2710.*

Agoseris rostrata sp. nov.

Leaves narrowly linear-lanceolate, about 2 dm. long, usually more or less laciniate with linear lobes, glabrous and glaucous; scape 2–6 dm. high, more or less villous, especially under the head; involucre fully 3 cm. high; outer bracts oblong or ovate, obtuse, glabrous, about half as long as the elongated linear or linear-lanceolate inner ones; corolla orange or purple; achenes fully 2 cm. long, with a very long and slender, not striate, beak.

In habit this most resembles *A. elata*, but the bracts and the achenes associate it with *A. grandiflora*.

COLORADO: Lower Boulder Cañon, 1901, *Osterhout 2478* (type); between Sunshine and Ward, 1902, *Tweedy 4895*.

Taraxacum leiospermum sp. nov.

Leaves spreading, oblanceolate, less than 1 dm. long, dark-green, obtuse or acutish, retrorse-dentate, rarely lobed; scape about 1 dm. high, slightly villous when young; outer bracts 7–10 mm. long, lanceolate with spreading tips; inner linear, about twice as long; neither corniculate; achenes greenish, ribbed, tuberculate above, but otherwise smooth.

Probably related to *T. augustifolium* Greene, but that is described as having much narrower leaves and erect outer bracts. It differs from *T. montanum* in the longer, narrower and spreading bracts and the less lobed leaves.

COLORADO: Tennessee Pass, 1902, *Osterhout 2645* (type); Seven Lakes, 1896, *E. A. Bessey.*

Two new species of Convolvulus from the western United States*

Homer Doliver House

The two species of *Convolvulus* described below are based upon plants from the collection made by C. S. Crandall in Colorado in 1896. *Convolvulus arvensis* L. is an European species widely introduced into America. There is found, however, an indigenous ally to it in the western states which appears to be distinct.

Convolvulus ambigens sp. nov.

Prostrate or trailing, annual, or perennial only at the base, branching, two to several dm. in length; finely cinereous-pubescent, rather densely so toward the tip, often glabrate below on the stem: leaf-blades ovate-oblong or triangular-oblong, 1.5–4 cm. long, abruptly acute, truncate or nearly so at the base, entire except for the acute, laterally-spreading basal auricles which are often sub-toothed below; petioles shorter than the blades: flowers axillary, solitary, often on erect leafy branches; peduncles 1.5–3 cm. long; pedicels slightly thickened: sepals oblong or suborbicular, about 3 mm. long, rounded at the apex: corolla rotate-funnelform, 1.5–2 cm. long, the subentire limb as broad, white or with pink stripes: stigmas linear.

In loose soil, among bushes and in fields, chiefly in river-valleys, Montana to New Mexico, Oregon and southern California. The type collected near Fort Collins, Colorado, by C. S. Crandall, *no. 4218*, June 22, 1896, in the herbarium of the New York Botanical Garden. Duplicate type of the same collection in the National Herbarium, sheet *no. 486121.* In addition to the type collection the following specimens may be referred here:

Along railroad near Fort Collins, *C. S. Crandall*, August 23, 1898. *C. S. Sheldon 11*, July 8, 1884. Reno, Nevada, *M. E. Jones*, June 11, 1897. Hot Springs, Arizona, *J. W. Toumey 222*, June 17, 1892.

Californian specimens differ from the type chiefly in their more pronounced pubescence, and must be referred here until they are better known.

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Convolvulus interior sp. nov.

Perennial with a horizontal rootstock, prostrate, or the tips rarely showing a tendency to climb, sparingly branched from the base, 2–8 dm. long; rather densely and very softly pubescent throughout, except on the upper leaf-surfaces, with shorter and longer woolly hairs, usually cinereous in appearance: leaf-blades deltoid or hastate-ovate, 2.5–4 cm. long, nearly as broad at the shallowly cordate or subtruncate base, glabrate or becoming glabrous above; the basal auricles inconspicuous, laterally spreading, rounded or obtusely angled; petioles as long as the blades or shorter: peduncles axillary, exceeding the subtending petioles but rarely the blades; bracts broadly ovate, obtuse, about one-third the length of the corolla, closely investing and surpassing the calyx: corolla white, 3.5–4 cm. long, the limb entire, 3–4 cm. broad.

In sandy soil, Nebraska and Colorado to Oklahoma and Arizona. The type collected near Fort Collins, Colorado, by C. S. Crandall, *no. 1625*, June 19, 1896, in the herbarium of the New York Botanical Garden. Duplicate type of the same collection in the National Herbarium, sheet *no. 486123*. The following specimens may also be referred here:

Fort Collins, Colorado, *J. H. Cowen 363*, June 22, 1893. Riley Co., Kansas, *J. B. Norton 354*, 1895. Oklahoma, *F. A. Waugh 361*. Indian Territory, on the False Washita, between Fort Cobb and Fort Arbuckle, *Dr. Edward Palmer 354*, 1868.

This species is perhaps nearest related to the eastern *C. repens* by its prostrate habit and pubescence, but differs greatly from it in the shape of its leaf-blades and its shorter corolla. It has also been referred to *C. americanus* (Sims) Greene, which is nearly or quite glabrous and an extensive twiner.

UNITED STATES NATIONAL MUSEUM.

Phytogeographical explorations in the coastal plain of Georgia in 1903 *

Roland M. Harper

My work in the coastal plain of Georgia in 1903 began on the eastern border of Effingham County, where the Seaboard Air Line crosses the Savannah River, about sunrise on June 12, and ended at Macon on September 25. During the summer notes and collections were made in the following counties: Effingham (nos. *1810–1815*, *1837–1840*), Chatham (*1816–1836*, *1841*, *1842*), Bryan (*1843–1850*), Tattnall (*1851–1862*), Montgomery (*1863–1872*, *1981–1990*), Telfair (*1873*), Dodge (*1874–1876*, *1977–1980*), Wilcox, Dooly (*1955–1964*). Sumter, Lee, Terrell, Randolph (*1877–1898*, *1903*), Quitman (*1899–1902*), Clay, Calhoun, Early (*1904–1914*), Miller (*1915–1919*), Decatur (*1920–1935*), Baker (*1936*), Mitchell (*1937*), Thomas (*1938*, *1939*), Colquitt (*1940–1948*), Dougherty (*1949–1954*), Worth, Berrien, Irwin, Houston (*1965–1967*), Bibb (*1968–1971*), Twiggs, (*1972–1976*), Pulaski, Coffee (*1991–1992*, *2010–2014*), Appling (*1993*, *1994*), Liberty (*1995*, *1996*), Wayne (*1997–1998*, *2007–2009*), Glynn, McIntosh (*1999–2006*), Pierce, and Macon (*2015–2018*). Numbers *1810–1866* were collected in June, *1867–1908* in July, *1909–1958* in August and *1959–2018* in September. Forty-two numbers of fungi and bryophytes, numbered separately, were also collected. During the season I traveled by rail through the coastal plain about 1400 miles (nearly half of which distance was through territory I had not previously explored), and took about 275 photographs.

On this trip I made considerable study of the Altamaha Grit, one of the most interesting (from a phytogeographical standpoint at least) and extensive (covering at least 11,000 square miles) geological formations in the state. Very little work has been done in

* Investigation prosecuted with the aid of a grant from the Herrman Fund of the Council of the Scientific Alliance of New York.

the region of this formation by other botanists,* and published references to it are scarce.

As the Altamaha Grit region (the common name of which, when it is distinguished from other portions of the coastal plain, is the "rolling wire-grass" or "rolling piney-woods" country), by reason of its many natural advantages, which have only comparatively recently begun to be appreciated, is increasing very rapidly in wealth and population,† largely at the expense of its once mag-

* The younger Bartram and the elder Michaux, whose routes through Georgia in the eighteenth century are pretty well known, could hardly have seen any of the Altamaha Grit region except perhaps the extreme eastern end of it There is evidence that at least some of Abbot's drawings of Georgia plants and insects, published in 1797, were made in this region, but no one knows exactly where. About 1830 Nuttall discovered *Arenaria brevifolia* in Tattnall County, presumably on an outcrop of Altamaha Grit, but very little is known of his movements in Georgia. Croom probably skirted the inland edge of this region on his travels through Georgia during the few years immediately preceding his death, but there is no recognizable description of it in his writings. And since the building of railroads probably as many as a dozen well-known botanists have passed through portions of the Altamaha Grit region, usually without stopping, or ventured into it for short distances, without knowing how it differed from the rest of the coastal plain, but very few of these have made public any notes or specimens from there. It is not surprising, therefore, that I should find new species in that region nearly every season. But for the fact that most of the plants indigenous to that part of the state are not endemic, but extend into the flat country near the coast, or into other states, a much larger proportion of them would still be undescribed.

† The nine counties in Georgia which increased in population over 75 per cent. between 1890 and 1900 are all wire-grass counties, wholly or in part. The three showing the largest increase (Colquitt, Irwin and Tattnall, with percentages of 184, 116 and 99 respectively) are entirely underlaid by the Altamaha Grit. During the same period the whole rolling wire-grass country increased in population over 60 per cent., the whole coastal plain of Georgia 28 per cent., the whole state about 20 per cent., and the whole United States (not counting islands acquired during the decade) about 22 per cent. The average density of population in the Altamaha Grit region in 1900 was about 25 to the square mile and that of the whole state 37.5. Fifty years earlier the region under consideration was regarded as almost a desert, and contained less than four inhabitants to the square mile. Even as late as 1880 the density of its population had not reached ten per square mile.

This region is remarkably free from weeds, mud, dust, floods, droughts, gullies, malaria, and extremes of heat and cold; all of which cannot be said of some other parts of the country. The topography is undulating enough to afford good drainage, and at the same time level enough to offer no serious obstacles to easy transportation (which is so essential for the rapid spread of civilization).

The principal source of wealth for this region has been — and will be for many years, if properly managed — *Pinus palustris*, which is probably at present the most important tree in North America from an economic standpoint, rivaling in the variety and usefulness of its products the classical palms and bamboos of the tropics. Increasing attention, however, is being paid to agriculture and manufactures.

nificent pine forests, any information in regard to its flora and other natural resources which can be placed on record now will increase in interest as the region becomes more thickly settled.

The rock which characterizes this part of the state is not known to contain any recognizable fossils, but it is believed to be of Upper Oligocene age. * It is nearly everywhere concealed by overlying Pleistocene deposits (principally Lafayette and Columbia), but in a few places, usually on slopes in dry pine-barrens, it comes to the surface, forming cliffs or sometimes flat outcrops. Such exposures were seen in 1903 in the counties of Tattnall, Coffee, Dodge and Dooly, and, as might be expected from their scarcity and previously unexplored condition, support a flora of

FIGURE 1. Outcrop of Altamaha Grit in open pine-barrens near Pendleton Creek, Tattnall County, June 26. *Liquidambar Styraciflua* in right foreground; the other trees are mostly *Pinus palustris*. This is one of the localities for *Selaginella arenicola* and *Talinum teretifolium*, mentioned below.

unusual interest. Among the species growing on such rocks are some which seem to be endemic to the Altamaha Grit region, and a still larger number which have been considered as characteristic

* For description of this formation see Dall & Harris, Bull. U. S. Geol. Surv. **84**: 81, 82. 1892.

of granite outcrops in the Piedmont region. Some of them will be discussed in the latter part of this paper.

The ordinary phase of the Altamaha Grit is readily distinguished, as far away as it can be seen, from all other coastal plain rocks by its surroundings and by the appearance of its weathered surfaces, which are just the color of pine bark or perhaps a little darker. (A fresh surface is pale-yellow or often coarsely mottled with red.) Other coastal plain rocks contain more or less calcium carbonate and are surrounded by dense vegetation, but the Grit crops out in broad daylight and is often visible half a mile away.

The Altamaha Grit as such is not known outside of Georgia, though it underlies about one-fifth of the state or a third of the coastal plain, and extends nearly to the Savannah River on the northeast and the Chattahoochee on the southwest. The Grand Gulf, * a formation believed to be of the same age, extends across the lower part of Alabama, Mississippi, Louisiana and Texas, but its actual continuity with our Grit has not yet been established.

The boundary between the rolling wire-grass region (Altamaha Grit) and the lime-sink region (Lower Oligocene) which adjoins it on the northwest in Georgia (and bears a similar relation to the Grand Gulf region in the states farther west), is one of the most trenchant boundaries in the coastal plain, and, when one becomes accustomed to it, is about as easily recognized as the fall-line. † In 1903 I traced this boundary, by crossing it at every convenient point, through the counties of Dodge, Wilcox, Dooly, Worth, Mitchell and Decatur. ‡ A striking feature of this inland edge of the Altahama Grit country, all the way across the state, especially toward the southwest, is that it is marked by

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* Named for Grand Gulf, a settlement on the Mississippi River in Claiborne County, Mississippi, where this formation was first distinguished by B. L. C. Wailes about fifty years ago.

† My first impressions of the change in aspect of the country in passing from one region into the other, traveling southward from Cordele in 1900, were described in the BULLETIN a few years ago (28 : 458. August, 1901). But my interpretation of the geological significance of this change, based on the best information available at that time, subsequent research has shown to be incorrect. (See correction above.) My remarks on *Pinus palustris* in that connection were also largely erroneous.

‡ In the spring of 1904 I traced it farther east, through the counties of Laurens, Emanuel and Screven, nearly to the Savannah River.

an escarpment facing inland, the Grit being everywhere higher than the limestone, doubtless on account of its greater resistance to erosion and solution. In Decatur County, traveling eastward or southward from Bainbridge by rail, one rises about 150 feet in three miles in ascending this escarpment. Elsewhere the difference in elevation is not so great, but always perceptible, as may be seen by examining the profiles of the railroads which pass from one of these regions into the other. From a point on the main Atlantic and Gulf divide a few miles east of Cordele, to the southwestern corner of the state, a distance of at least 100 miles, this escarpment coincides nearly if not exactly with the divide between the Flint River and all the streams flowing into the Gulf east of it.

A similar escarpment is said to mark the inland edge of the corresponding Grand Gulf region in Mississippi and Louisiana.* I am also informed by Dr. Eugene A. Smith, who is familiar with the Grand Gulf region of Alabama and Mississippi and has traveled through the Altamaha Grit region of Georgia, that the topography and flora are essentially the same in both. In 1846, some years before the Grand Gulf formation was named, Artemas Bigelow † described and figured some rock outcrops in Baldwin County, Alabama (now mapped by Dr. Smith as being in the Grand Gulf region), which must be very similar to the Altamaha Grit outcrops in Georgia. That portion of Alabama is described by Dr. Mohr in his "Plant Life of Alabama" ‡ under the name of "lower division of the coast pine belt," but without emphasizing its geological significance.

The southeastern limit of the Altamaha Grit is ill-defined, for the rolling pine-barrens seem to pass by imperceptible gradations into the flat pine-barrens near the coast. Midway between the Savannah River and the Chattahoochee the region under consideration is at least sixty miles wide; but in the vicinity of Climax, in Decatur County, where its limits are pretty sharply defined, its width is not over six miles, and it probably tapers down to nothing a little farther on.

* See Hilgard, Am. Jour. Sci. III. **2**: 397. 1871; III. **22**: 59. 1881: Dall & Harris, Bull. U. S. Geol. Surv. **84**: 161, 168. 1892; Harris & Veatch, Rep. Geol. La. **1899**: 96. 1900; Veatch, Rep. Geol. La. **1900–02**: 156. 1902.

† Am. Jour. Sci. II. **2**: 419–422.

‡ Contr. U. S. Nat. Herb. **6**: 110–118. 1904.

The typical topography of this region (as is finely displayed around Tifton, for example) is gently rolling, less so of course than in Middle Georgia, but decidedly more so than in the adjoining lime-sink region. A straight line drawn in any direction across the rolling wire-grass country would cross, on the average, two or three valleys to the mile, the bottom of each valley containing a sluggish and often intermittent stream, the water of which is never muddy but usually tinged with brown from vegetable matter. The average difference in elevation between the smaller valleys and the adjacent ridges is probably twenty or thirty feet. Creeks and rivers are of course encountered at longer intervals.

Probably at least nine-tenths of this region, in its natural condition, is pine-barrens, and the remainder is mostly swamps, which border every stream, and sand-hills, which occur along most of the creeks and rivers. The lime-sink region, in Southwest Georgia at least, is also about nine-tenths pine-barrens, the remainder being mostly river-swamps, ponds and lime-sinks. Streams are as scarce in the lime-sink region as they are numerous in the Altamaha Grit country. In August, 1903, I went on foot from Bainbridge (on the Flint River) west to the Chattahoochee, a distance of about twenty-eight miles, and did not see a stream of any kind between the two rivers except Spring Creek, which rises in the Eocene country about thirty miles to the northward.

Ponds are less frequent in the region under consideration than in some other parts of the coastal plain, and those that do occur are almost invariably shallow enough to dry up every year, and full of trees (principally *Pinus Elliottii*, *Taxodium imbricarium*, and *Nyssa biflora*); never containing a dense growth of glumaceous plants (such as *Manisuris Chapmani*, *Panicum digitarioides*, *Homalocenchrus hexandrus*, *Eleocharis*, *Dichromena*, *Rhynchospora*) or shrubs (*Crataegus aestivalis*, *Hypericum fasciculatum*, *Cephalanthus*), like many of those along the inland edge of the lime-sink region, or deep and permanent enough to contain species of *Potamogeton*, *Utricularia* and various *Nymphaeaceae*, like the large ponds of Decatur and Lowndes counties. Another interesting feature of this region is that it contains nearly all the sand-hills of the coastal plain, with the exception of those along the fall-line.

The following species are common and conspicuous in the

Altamaha Grit region, but unknown in the adjacent lime-sink region: *Pinus serotina*,*† *Sarracenia flava*,‡ *Cliftonia monophylla*,§ *Nyssa Ogeche*,†§ *Pinckneya pubens*,*†§ *Viburnum nudum*,* and *Baldwinia atropurpurea*.†|| Many others having a similar distribution might be mentioned, but the above are of particular interest because they extend right up to the edge of the region, and are easily recognized from a moving train, enabling the observant traveler to tell in a few minutes when he enters the Altamaha Grit country from the north or west.

On the other hand, many species which are common in other parts of the coastal plain are conspicuous by their absence in the wiregrass country. The following grow both north and south of the region under consideration, sometimes approaching within a mile of it, but are not known within its borders: *Phegopteris hexagonoptera*, *Uvularia perfoliata*, *Fagus Americana* (and therefore *Epiphegus* too), *Sassafras*, *Kalmia latifolia*, *Asclepias variegata*, and *Conopholis*. The same is true of several species confined to limestone outcrops or permanent ponds, which it would be superflous to mention here. Again, several river-bank trees, such as *Populus deltoides*, *Platanus*, *Acer saccharinum* (*A. dasycarpum*), *Negundo* and *Catalpa*, descend the larger streams nearly or quite to the Altamaha Grit and seem to stop there. And there is a considerable number of species which range from the mountains to the inland edge of the Grit and no farther, but these are too numerous to be discussed here. When the whole truth is known the Altamaha Grit escarpment will probably be found to stop as many species of plants as the fall-line does, though not for the same reasons.

Of the points of interest visited in the summer of 1903 only a few need be mentioned here.

On the morning of my arrival in Georgia, after following down

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* Reappears northwest of the lime-sink region.

† Not known in Alabama. There is probably a gap between the Altamaha Grit and Grand Gulf regions which these species have not succeeded in crossing.

‡ In Georgia the distribution of this species coincides pretty closely with that of the Grit. But in Virginia and the Carolinas it is found farther inland.

§ Reaches its northeastern limit in the extreme southern corner of South Carolina.

|| Not known in South Carolina (in which State nothing corresponding to the Altamaha Grit has yet been reported).

the Savannah River a few miles from the point where I crossed it, I found myself at Sisters' Ferry, where William Bartram crossed the river on April 25, 1776,* and André Michaux and his son on April 26, 1787.†

Bartram mentioned particularly the occurrence of *Dirca palustris* on the Georgia bank at this point, and Michaux noted, besides the *Dirca*, *Kalmia latifolia*, two azaleas and a few other shrubs.

FIGURE 2. Sisters' Ferry, on the Savannah River (Effingham Co., Georgia, and Hampton Co., South Carolina), looking upstream from the Georgia side. June 12. This is the place where Bartram and Michaux crossed in the eighteenth century.

I had no difficulty in finding the *Dirca* and *Kalmia*, and secured specimens of them (nos. *1815*, *1814*). Both species are very rare so near the coast in this latitude and at so low an altitude (probably not over 50 feet above sea-level). At that time I was not aware of Michaux's visit, and I did not notice the azaleas (which must have been past flowering then) and other plants mentioned by him, one of which seems to have been the recently

* See Bartram's Travels, page 307 (of 1794 edition). The year may have been 1777; for the dates in different parts of this work contradict each other, and I have not yet determined which are correct.

† Journal of André Michaux (edited by C. S. Sargent), page 9. On page 12 is a reference to a subsequent visit to the place on May 13 of the same year.

revived *Magnolia pyramidata* Pursh.* The geographical features of the vicinity of Sisters' Ferry, and in fact the whole east side of Effingham County, are rather peculiar, recalling those of the Chattahoochee region of Decatur and Thomas counties. But nothing definite is known about the geology of this county, and the high water prevented me from getting much light on the subject from the rocks along the river.†

On July 31 I discovered something previously unknown to science and entirely unexpected, viz., sand-hills on the Chattahoochee River. These are located on the left or Georgia side in Early County near Hilton. At all other easily accessible points on the Chattahoochee there is not the slightest suggestion of sand-hills, and I was informed that this particular area is only four or five miles long. Where I crossed it it is about a mile and a half wide. These sand-hills have the same general appearance as many of those in Southeast Georgia, but their flora is not nearly so rich in species, which is just what would be expected from their remoteness from other similar areas.

About the middle of August I went to River Junction, Florida, about two miles south of the Georgia line, examined *Tumion taxifolium* ‡ in its native haunts near there, and then spent nearly two days walking up along the Flint River to Bainbridge, a distance of about thirty miles, trying to find this rare tree in Georgia. In this particular I was unsuccessful, but the trip was by no means unprofitable. In this extreme southwestern corner of the state the phytogeographical features are rather complicated, and therefore interesting, but my time there was too short to make more than a superficial examination.

For the last fifteen miles of its course the Flint River (whose junction with the Chattahoochee marks the corner of the state) washes the northwestern base of an escarpment which is nearly 200 feet high in some places. This is a direct continuation of the

* See Small, Fl. S. E. States 452. July, 1903; Sargent, Trees and Shrubs 1: 101, *pl. 51*. November, 1903.

† This was just after one of the most disastrous floods ever known in South Carolina, and the Savannah River at this point was then nine feet above low water mark and still rising. I noticed however some fossiliferous rocks just above the water's edge.

‡ The odor of the bruised foliage of this tree is frequently mentioned, but I have never seen it described. It reminded me of the odor of the foliage of *Lycopersicum* more than anything else.

Altamaha Grit escarpment mentioned above, but down here in Decatur County, if not for some distance farther east, its base seems to be composed of rocks of a different formation, apparently the Chattahoochee.* The slopes next to the river support a fine forest of angiospermous trees, as is characteristic of the Chattahoochee region. (The transition from the shady woods of the slopes to the open pine-barrens of the summit is very abrupt at Climax and Fowlstown.) At some points along the brow of the escarpment near the river, where the forest has been partly removed, one can get a surprisingly extensive view of the much lower and comparatively level country across the river to the northwestward. At such points the horizon in that direction is so distant that it appears to the unaided eye as a perfect, unbroken, straight line, though doubtless composed of the tops of pine trees.

On top of this escarpment near the Flint River, particularly in the vicinity of Faceville, many square miles are covered with a thick deposit of dry Columbia sand. This supports a flora similar to that of the sand-hills of Southeast Georgia, but differs from all regular sand-hills in its unusual height above the river. It is like the majority of them, however, in being within the Altamaha Grit region, and on the left side of the stream.

Some maps of Georgia show in the northern part of Appling County a pond, which if it is as large as represented must be quite unlike anything else in the Altamaha Grit region. On September 12th, as I was passing through the county, I spent a few hours between trains in trying to find out something about this place. Getting off at Prentiss, the nearest station, I directed my steps northeastward, and after traveling a couple of hours through flat pine-barrens I approached my destination. But I found the pond surrounded by such a dense growth of evergreen trees and shrubs (such as *Magnolia glauca*, *Gordonia*, *Cliftonia*, and *Pieris nitida*) that I could not get a glimpse of it; and the few natives living in

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* The portion of this escarpment in Decatur County has been described by Pumpelly (Am. Jour. Sci. III. **46**: 445–448. December, 1893) and Foerste (Am. Jour. Sci. III. **48**: 41–54. July, 1894), but neither of these authors seems to have indicated the occurrence of Altamaha Grit on top of it. I have seen no rocks of this formation farther west than Worth County, but its characteristic topography and flora extend uninterruptedly and unmistakably well into Decatur County. Moreover, the rocks of the Chattahoochee formation are not hard enough to form such an escarpment.

the vicinity do not seem to know much about it, and have not even given it a name, apparently. But from the nature of its surroundings and other considerations, I imagine that this pond must be a good deal like Okefinokee Swamp, on a small scale. Within a mile of the pond the sand is deeper and drier than usual, with a sort of sand-hill flora much like that around the large ponds in the lime-sink regions of Decatur and Lowndes counties.*

Later in September I did some work along the Altamaha River, in the vicinity of the two points where railroads cross it (near Doctortown and Barrington) and around Darien, the seaport at its mouth. Like most of its tributaries, the Altamaha has sand-hills along its left bank, but they are not as extensive (where I saw them, at least) as those farther inland, and their flora seems less varied. Opposite Doctortown the sand-hills are not over a mile wide, near Barrington (station) they are much narrower, and they disappear entirely somewhere above Darien. At both points where I crossed the river its swamp is about a mile wide, containing several elongated "lakes" (bayous they would probably be called farther west), and happens to be all on the left or sand-hill side. The bridge near Barrington is not over twenty miles from the ocean, but the volume of flow of the river is such that the influence of the sea is not felt by the vegetation there, and I was informed that the tide is perceptible only when the river is very low. (The smaller rivers, such as the Ogeechee, Satilla and St. Mary's, at this distance from the coast have several feet of tide and are bordered by brackish marshes.) Even at Darien, which is within ten miles of the open ocean, the river marshes are fresh or nearly so, and contain a good deal of *Taxodium distichum*. Coming up by steamer from Brunswick to Darien the gradual transition from salt to fresh marshes can be plainly seen, the composition of the vegetation changing almost completely while its general aspect remains about the same.

A few miles above the railroad bridge near Barrington is the lowest ferry on the Altamaha, where the Bartrams, father and son, crossed in the 18th century, and discovered that now long-lost tree, *Franklinia Alatamaha* or *Gordonia pubescens*, as it is variously called.† Somewhere near the same point *Leitneria floridana* was

*See Bull. Torrey Club **30**: 291. 1903; **31**: 15. 1904.

† For an account of several attempts to rediscover this tree see Ravenel, Am. Nat. **16**: 235–238. 1882.

found by C. L. Boynton in July, 1901.* My itinerary did not bring me within sight of either of these rare plants, however.

The new species resulting from this trip which have been recognized up to the present writing all happen to belong to groups with which other persons are more familiar than myself, so none are described in this paper. Among the lower cryptogams one moss has already been described by Cardot,† another by Warnstorf,‡ and a fungus by Dr. Murrill. § The first is based on two collections from the lime-sink region, one made in 1902 and one in 1903; and the other two new species are each based on a single collection from the Altamaha Grit region.

Among the pteridophytes and spermatophytes collected in 1903 the following seem worthy of notice:

SELAGINELLA ARENICOLA Underw. Bull. Torrey Club **25**: 541. 1898

Previously known only from Columbia sand in Florida, and Decatur County, Georgia. I have seen it only on Altamaha Grit outcrops in Tattnall County (*nos. 1854, 1860*), where it is quite scarce.

SELAGINELLA ACANTHONOTA Underw. Torreya **2**: 172. 1902

On driest sand hills in Tattnall (*no. 1852*), Montgomery (*no. 1987*) and Liberty counties. A form not quite typical, approaching *S. rupestris*, was collected on an Altamaha Grit outcrop in Dooly County (*no. 1957*). This species was previously known only from North Carolina, unless some Florida specimens are to be referred to it.

SAGITTARIA NATANS Michx.

In shallow grassy pools just west of Savannah, all submersed but the flowers, June 17 (*no. 1831*). This species has an interesting contrivance for protecting its reproductive organs from water. Whenever by any cause the inflorescence is drawn beneath the surface, the pressure of the water causes each flower to

* See Biltmore Bot. Stud. **1**: 143. 1902.

† Rev. Bryol. **31**: 8. 1904.

‡ Bot. Centrabl. Beihefte **16**: 252. 1904.

§ Bull. Torrey Club **31**: 600. 1904.

shut up immediately, enclosing a large bubble of air which keeps the interior dry, and at the same time gives the flower buoyancy to rise to the surface again. This perhaps does not happen often in nature, but the experiment may be performed repeatedly with the same flower.*

ARISTIDA CONDENSATA Chapm.

Collected on Sept. 10 on the sand-hills of Gum Swamp Creek on the western border of Montgomery County (*no. 1982*), and seen later in the same month on the sand-hills of the Altamaha River in Liberty and McIntosh counties, and of the Little Satilla

FIGURE 3. *Selaginella acanthonota* (*no. 1987*) on sand-hills of Little Ocmulgee River, Sept. 10. Photograph taken in dry weather, when the stems were all more or less incurved.

in Wayne County near Hortense. Previously reported only from Florida.

* Since the above was written I notice that the same observation has already been made by Professor Hitchcock (Proc. Iowa Acad. Sci. 9: 215. 1902). But as his note is likely to be overlooked this may as well stand.

FIMBRISTYLIS DIPHYLLA (Retz) Vahl, Enum. **2**: 289. 1806

Common along moist sandy roadsides in and near the swamp of Big Indian Creek on the road from Hayneville to Perry, Houston County, Sept. 3 (*no. 1967*). Also seen the next day in similar situations east of Mossy Creek on the road from Perry to Kathleen, in the same county. This is a tropical species, not previously reported from the United States. Dr. Britton, who identified it, tells me that in the West Indies it is principally a roadside weed also, so that its native habitat is more or less problematical. It is rather remarkable that it should penetrate 200 miles into the interior of Georgia, and establish itself in such localities as the above, several miles from any railroad or settlement, before being detected. What seems to be the same thing was collected on a moist exposed grassy bank at the edge of the Altamaha River marshes just below Darien, two weeks later (*no. 2004*). Its occurrence at this seaport is not so surprising, but even there it appeared to have been long established, and should have been seen before.

LUZULA SALTUENSIS Fernald, Rhodora **5**: 195. 1903

(*L. vernalis*, *L. pilosa* and *Juncoides pilosum* of American authors.)

Seen in rich shady woods on a north slope a few miles northwest of Cuthbert, July 21. Quite rare. This discovery extends its known range about 150 miles southward, and well into the coastal plain. (The opportunity to combine the new specific name with the other generic name now in use will probably not long be neglected, but in the meanwhile we prefer to use the name as above.)

ALETRIS LUTEA Small, Bull. N. Y. Bot. Gard. **1**: 278. 1899

This plant has the aspect of *A. farinosa* with flowers colored almost like those of *A. aurea*. Besides its individual characters (*i. e.*, such as might be exhibited by a single specimen without a label), it differs from the former in range and from the latter in time of flowering, being a month or two earlier. I collected it on June 15 in rather dry pine barrens near Sandfly, Chatham County (*no. 1828*). It was not previously known north of Florida.

CANNA FLACCIDA Salisb.

Like several other species confined to the southeastern United States, this has been greatly neglected by modern bibliographers.

In trying to verify some of the citations for it I found to my surprise that it had been described at least thirty times, and figured eight or ten times. Its bibliographic history is somewhat involved. The principal descriptions, in chronological order, are as follows:

Cannacorus glaucophyllos (etc.), Dill. Hort. Elth. 69. *pl. 59.* 1732. Type locality: "si bene memini, . . . e Carolina, ubi sponte nascitur."

Canna glauca L. Sp. Pl. 1. 1753 (in part). Type locality: "In Carolina?"

? C. glauca L.; Lam. Encyc. 1: 357. 1783. Locality: "dans les lieux humides de la Carolina: on la cultive au Jardin du Roi."

C. flaccida Salisb. Ic. Stirp. Rar. 3. *pl. 2.* 1791. Type locality: "Sponte nascentem in *South Carolina* legit *Johannes Bartram.*"

? C. flava Michx.; Lam. Jour. Hist. Nat. Par. 1: 416. 1792. (*Fide* Ind. Kew.)

C. flaccida Salisb.; Mill. Gard. Dict. (ed. Martyn). 1797. The editor says among other things "It is often confounded with *Canna glauca.*"

C. glauca β flaccida Willd. Sp. Pl. 1: 4. 1798. Locality: "in Carolinae aquosis."

C. flaccida Salisb.; Redouté, Les Liliacées 2: *pl. 107.* 1805. (Specimen figured was cultivated at Malmaison. The author remarks that Fraser and Michaux mention no indigenous *Canna* from Carolina, and as this species is more sensitive to cold than other plants from Carolina, perhaps it came originally from some warmer country. But this is probably explained by the fact that it grows in the extreme southern part of South Carolina, while the other Carolinian plants known to Redouté may have come from the mountains of North Carolina.)

C. flaccida Salisb.; J. E. Smith in Rees Cycl. vol. 6. 1806. "A native of South Carolina, where it was found by Bartram."

C. flaccida Roscoe, Trans. Linn. Soc. 8: 339. 1807. (This is the citation given in the Kew Index.) Type-locality: "Bot. Gard. Liverpool."

C. flaccida Roscoe; Pursh, Fl. Am. Sept. 585. 1814. Locality: "In swamps of South Carolina" (with reference to six earlier descriptions or figures, including Salisbury's and one which I have not seen).

C. flaccida Roscoe; Ell. Bot. S. C. & Ga. 1: 1. 1816. "Grows in wet soils, around ponds; Paris Island, near Beaufort; C[h]atham Co., Georgia."

C. flaccida; Nutt. Gen. 1: 1. 1818. "In Carolina and Georgia."

C. flaccida; Lodd. Bot. Cab. 6: *pl. 562.* 1821. "A native of Carolina and Georgia; we received it about two years since from our valued friend, Dr. Wray of Augusta."

C. flaccida Dill.; Roscoe, Scitamineae (no. 6). 1828. "A native of America, where, Mr. Nuttall informs me, he saw it growing in great quantities on the banks of the Mississippi. Has been cultivated in our gardens many years." (Refers to Dillenius's and Redouté's figures, but not Salisbury's.)

C. Reevesii Lindl. Bot. Reg. 23: *pl.* 2004. 1837. Type-locality: "China."

C. flaccida; Darby, Man. Bot. S. States 247. 1841. "Yellow. May–July. Wet soils. Low country of Car. & Ga. 2–3 feet." (Describes the flowers as red in subsequent editions.)

Eurystylus flaccidus Bouché, Linnaea 18: 485. 1844. (Refers to Salisbury and Willdenow, but mentions no locality.)

Canna flaccida Roscoe; Chapm. Fl. S. States, 466. 1860. (With the longest description in this book and in the three subsequent editions.) Locality: "Miry swamps, Florida and South Carolina, near the coast."

C. flaccida Salisb.; André, Rev. Hort. 1861: 316–320. *f. 79, 80.* 1861.

Eurystylus flaccidus Bouché; Horan. Prodr. Monog. Scit. 18. 1862. Locality: "In paludosis Carolinae australis."

Canna (§ *Corythium*) *flaccida* Roscoe; Wood, Class-Book 692. 1861. "A fine plant, around ponds, S. Car., Ga. and Fla."

C. flaccida Dill.; Regel, Ind. Sem. Hort. Petrop. 1866: 85. 1867. (Unites *C. Reevesii* with *C. flaccida*, probably for the first time.)

C. flaccida; Gray, Field, Forest & Garden Bot. 327. 1869. "Wild in swamps from South Carolina S."

C. flaccida Dill.; B. & H. Gen. Pl. 3^2: 655. 1883. "Species boreali Americana."

C. flaccida Dill.; Petersen in Engler & Prantl, Nat. Pflanzenfam. 2^6: 32. 1889. "Aus dem südlichen Nordamerika."

C. flaccida Salisb.; Petersen in Mart. Fl. Bras. 3^3: 74. *pl. 17. f. 2.* 1890. (Cites a recent Florida specimen, and follows Roscoe in crediting the species to the banks of the Mississippi.)

C. flaccida Salisb.; Baker, Gard. Chron. III. 13: 196. 1893. ("Southern United States; Carolina to Florida, in swamps." Also explains the origin of *C. Reevesii.*)

C. flaccida Salisb.; Bailey, Field, Forest & Garden Bot. 413. 1895; Cycl. Am. Hort. 240. 1900. "Swamps, S. Car. to Fla., near the coast."

C. flaccida Roscoe; Small, Fl. S. E. States 307. 1903. "In swamps near the coast, South Carolina to Florida."

Pursh, Elliott, Chapman, Wood, Small and the Kew Index credit the authorship of the specific name *flaccida* to Roscoe, while Roscoe, Regel, Petersen and Bentham & Hooker credit it to Dillenius, about seven authors credit it to Salisbury, and the remainder do not say where the name originated.

The facts in the case seem to be as follows: Our plant was figured and described in 1732 by Dillenius (but the word *flaccida* does not appear in his polynomial designation), who says the seeds came from Carolina, to the best of his recollection. By Linnaeus it was confounded with *C. glauca*, a very distinct species (if the published figures of it are accurate) of unknown origin. In 1788 Walter reported three species of *Canna* (the same three as in Linnaeus' *Species Plantarum*) from South Carolina, but it is not certain which of his descriptions (if any) applies to the plant in question. In 1791 our plant received its first tenable name from Salisbury, who gave an excellent hand-made colored plate and over a page (a folio page at that) of description. The name *flaccida* was used by at least four other authors before Roscoe, so there is no sufficient reason why it should have ever been credited to him. I have not been able to verify the citation of *C. flava*

Michx., said to have been published in 1792, but there is no *Canna* in Michaux's *Flora*, which appeared eleven years later.

In 1837 Lindley described *C. Reevesii*, from China, saying among other things: "It is very near *C. flaccida*; so very near that it may be doubted whether it is distinct." Baker, in his re-

FIGURE 4. Colony of *Canna flaccida*, in low woods in Chatham County, June 13.

vision of the genus, states that *C. Reevesii* is genuine *C. flaccida*, cultivated and not native in China, and that the same thing has also been seen in cultivation in the Himalayas.

In 1844 *Canna flaccida* and the then supposed distinct *C. Reevesii* were made by Bouché the sole representatives of his new genus *Eurystylus*, which does not seem to have been generally adopted. In 1861 Wood, noticing independently the peculiarities of *C. flaccida*, proposed the sectional name *Corythium* for it. It is not surprising that our plant should differ considerably from other species of *Canna*, for they are mostly confined to the tropics, while *C. flaccida* is definitely known only from South Carolina, Georgia and Florida. (But Roscoe says Nuttall found it on the Mississippi; a statement which deserves investigation.)

Whether there are any other native cannas in this country or not is a little uncertain. Walter describes three species, as already noted, and Bartram (*Travels*, page 424) mentions a luxuriant growth of *C. indica* along the Amite River in Louisiana in the 18th century,* at which time one would hardly suppose it could have been an escape. Pursh also mentions *C. angustifolia* L. as having been collected in Georgia by Enslen.

Canna flaccida (or horticultural varieties of it) is often seen in cultivation, but it is not certain how and when it first reached the European gardens from which it has since been distributed. Its occurrence in China early in the 19th century or before is a mystery, unless perhaps it is indigenous there after all, like some other plants of the Eastern United States. Another puzzling thing is that most European authors have described the leaves of this species as glaucous, but this does not seem to be true in the wild state.

In my 1903 collection *Canna flaccida* is represented by *no. 1819*, collected on June 13 in Chatham County about nine miles west of Savannah. At this point it grows abundantly (and often six feet tall) in low woods and even spreads over an adjacent railroad embankment. (There can be no question that it is indigenous there, though.) I saw it from a train at the same place two years before, and in August, 1902, I noted it in Charlton and Camden counties, as well as in the adjoining Nassau County, Florida, where it grows in swamps from which the Lafayette formation seems to be absent, as shown by the occurrence of *Taxodium distichum* and certain other significant plants. The photographs reproduced here are perhaps the first ever taken of this species in a wild state.

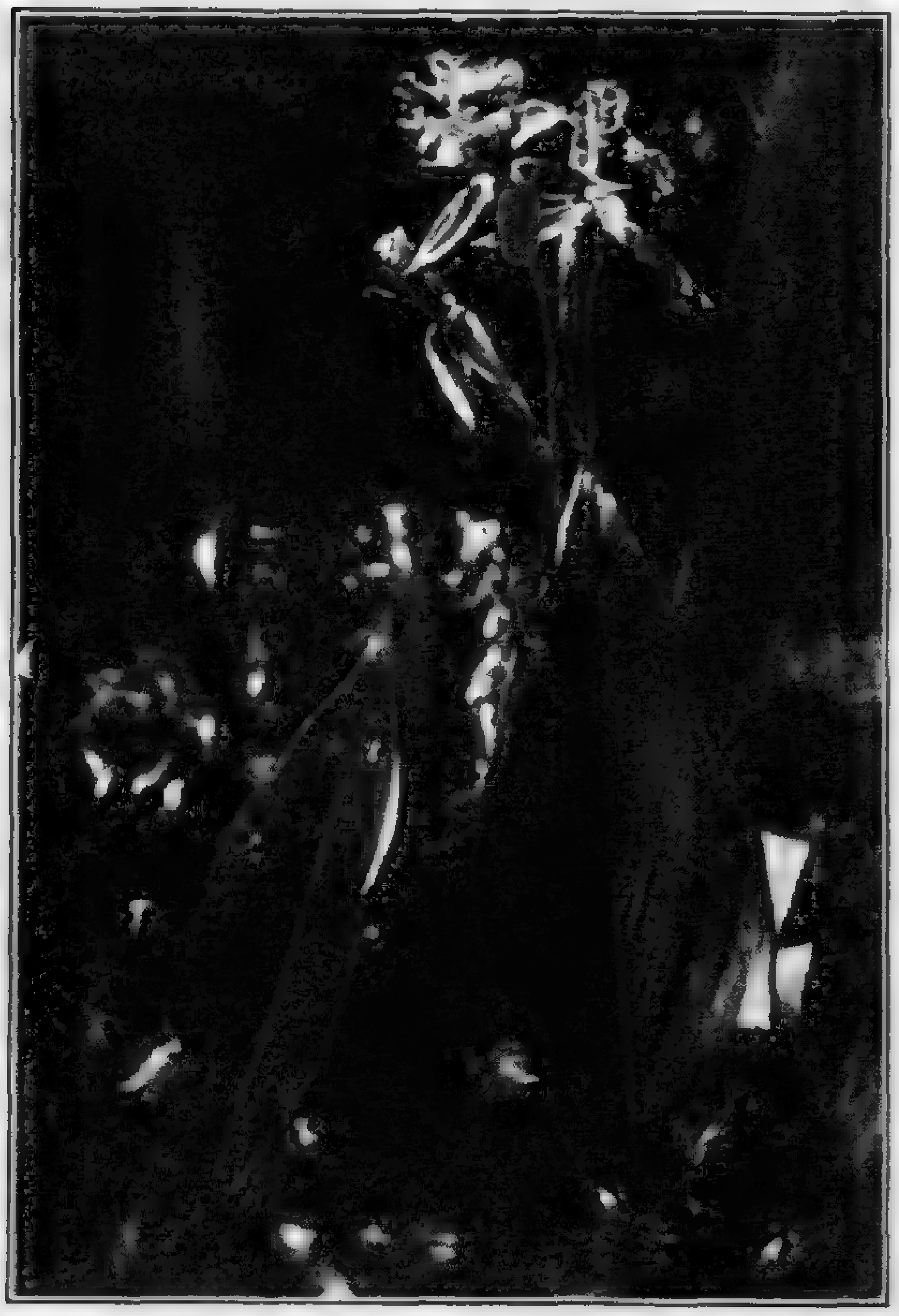

FIGURE 5. Nearer view of a single specimen of *Canna flaccida* (*no. 1819*).

* *Canna elegans* Raf. (Fl. Lud. 143. 1817) is based on Bartram's description.

EPIDENDRUM CONOPSEUM R.Br.

This, the only epiphytic orchid whose range extends into Georgia, is very hard to find until one becomes acquainted with it, as I know from my own experience and that of some other botanists, and there are few reliable records of its occurrence in the state. Consequently I was agreeably susprised to find it in full bloom near the western corner of Montgomery County on July 3 (*no. 1870*). This locality is about 110 miles from the coast and 200 feet above sea-level. Later in the season I saw it in Dodge County near Eastman, in Dooly County near Cordele, and in Early, Decatur and Thomas counties. The Dooly County station is about 125 miles from the Gulf (the nearest salt water), and 300 feet above sea-level. At all these stations it grew on *Magnolia grandiflora*, and usually high up out of reach. Its preference for this tree was noted long ago by Nuttall, who says in his *Sylva of North America* (**1**: 97): "It appeared there [near Savannah] to grow on no other tree;" as well as by Elliott and perhaps other writers.

POLYGONELLA CROOMII Chapm. Fl. S. States 387. 1860

Type-locality: "In Carolina or Georgia, probably in the middle districts, *Croom*."

I would refer to this little-known species my specimens collected on the sand-hills of Gum Swamp Creek in Montgomery County, September 10 (*no. 1985*). At that time it was just beginning to flower. Ten weeks earlier I had seen the same thing, without flowers, in similiar situations in Tattnall County. It is a diminutive shrub, not over a foot high and wide, and probably lives only a few years.

Dr. Small in his remarks on this genus a few years ago * refers *P. Croomii* to *P. brachystachya* Meisn., a Florida species, and in so doing states that "the labels show that *Polygonella Croomii* is from 'South Florida,' and not from 'Carolina or Georgia' as Dr. Chapman records in the Flora of the Southern United States." This is not strictly correct, however, for the original label (in Chapman's handwriting) says "South Florida?" showing that Chapman was in doubt about the locality, as he had good reason

* Bull. Torrey Club **23**: 407. 1896.

to be, for there is no evidence that Croom was ever in South Florida. It is not unlikely that Croom got his specimens of it on the sand-hills of Brier Creek, on the road from Augusta to Louisville, where he is known to have collected several other interesting plants.

The original specimen is too fragmentary to be of much value for purposes of comparison, but what there is of it seems to be identical with my *no. 1985*. It has longer spikes than *P. brachystachya*, but it is not necessarily specifically distinct. (With this possible exception there is at present no valid species bearing the specific name *Croomii*.)

TALINUM TERETIFOLIUM Pursh

Grows on dry outcrops of Altamaha Grit in the pine-barrens of Tattnall (*no. 1859*, June 26) and Dooly counties, where it seems as much at home as on granite rocks in Middle Georgia. Not previously known from the coastal plain. (It is reported from Florida in Dr. Small's Flora, but I can find no specimens to confirm this.)

PARONYCHIA RIPARIA Chapm.

This species, for a long time known only from the banks of the Flint River in the lime-sink region, now turns out to be not uncommon in Southeast Georgia. In June I saw it more than once in Tattnall County, on July 3 I collected it at the base of the sand-hills of Gum Swamp Creek in Montgomery County, where it was abundant (*no. 1869*), and in September I saw it on both sides of the Ocmulgee River near Lumber City, and on the sand-hills of the Altamaha in Liberty and McIntosh counties.

GIBBESIA RUGELII (Shuttl.) Small

In the Altamaha Grit region near the base of the sand-hills of the Little Ocmulgee River in Montgomery County opposite Lumber City, September 10 (*no. 1990*). Previously known only from Florida and the lime-sink regions of Decatur and Lowndes counties.

CERATOPHYLLUM DEMERSUM L.

On August 27 I found some magnificent but apparently sterile specimens of this (*no. 1952*) growing in a clear cool stream four or five feet deep issuing from a "blue spring" in the Flint River swamp in Dougherty County a few miles below Albany. The plants were often a yard long or more, and presented a beautiful appearance waving to and fro about the white sandy bottom.

Blue springs are common along some of the streams of the lime-sink region, particularly the Flint River, which flows through this region 100 miles or more. They are the outlets of bold subterranean streams, and their bluish color is due to the dissolved limestone. This particular spring, known in the vicinity as *the* Blue Spring, has been visited by several botanists and at least one geologist, and I am informed by the latter that its flow is about 70,000,000 gallons a day.

PODOSTEMON CERATOPHYLLUS Michx.

Collected on August 26 on submerged limestone rocks in very swift water at the shoals of Muckafoonee * Creek near its confluence with the Flint River a mile or two above Albany (*no. 1950*). Not previously reported from the coastal plain. †

The proposed conversion of these remarkable shoals into a source of water-power threatens the destruction of the *Podostemon*.

TIARELLA CORDIFOLIA L.

Observed in rich damp shady woods in Clay County near Fort Gaines on July 23. Rare. This seems to be its southern limit, as far as known. Dr. Mohr ‡ has reported it from Suggsville, Alabama, which is in the same latitude (31°35′), and Wood § mentions its occurrence near Eufaula, Alabama, which is about twenty miles farther north.

CRATAEGUS GEORGIANA Sarg. Bot. Gaz. **33**: 113. 1902; Silva N. Am. **13**: 63. *pl. 649*. 1902.

The only *Crataegus* I collected in 1903 (*no. 1973*) belongs to this species, according to Mr. Beadle, who identified it. It was

* A modern name, coined a few years ago by citizens of Albany for this creek (which is only a mile or two in length) from the names of its two affluents, Muckalee and Kinchafoonee.

† An early and little-known record of a Georgia station for this species (in the Paleozoic region) occurs in a paper by Julien Deby, entitled "Relation succincte d'une excursion faite aux bords de l Oostanaula en Géorgie, États-Unis" (Bull. Soc. Malacol. Belg. **12**: (3)-(7). 1877).

‡ Contr. U. S. Nat. Herb. **6**: 534. 1901.

§ Class-Book 370. 1861.

previously known only from the type-locality, "low meadows, in rich moist soil near Rome," in the Palaeozoic region; but I found it in the swamp of the Ocmulgee River in Twiggs County about a mile above Westlake, on September 7. There it was associated with two palmettos, *Rhapidophyllum Hystrix* and *Sabal Adansonii*, which are of course wanting at the type-locality. But the two localities have at least one feature in common, calcareous soil. My specimens came from a small tree about two inches in diameter and fifteen feet tall.

PETALOSTEMON FEAYI Chapm.

Collected on the sand-hills of the Altamaha River in Liberty County, September 14 (*no. 1995*); mostly past flowering. Previously known only from peninsular Florida. This plant bears a striking resemblance to *Kuhnistera pinnata*, for which it might easily be mistaken when not in flower.

GERANIUM MACULATUM L.

Seen in rich woods at several points in the northern half of Randoph County, July 16, 17 and 18. Apparently not reported from the coastal plain before.

EUPHORBIA FLORIDANA Chapm. Fl. S. States 401. 1860

E. sphaerosperma Shuttl.; Boiss. in DC. Prodr. **15**^{2}: 102. 1862; Ic. Euph. 17. *pl. 54*. 1866.

Tithymalus sphaerospermus Small, Fl. S. E. States 719. 1903.

Collected in dry sand (sand-hills?) near the Flint River between the state line and Recovery, Decatur County, August 14 (*no. 1931*). Previously known only from Florida and Alabama. (A chance to make a new combination will be noticed in the above synonymy.)

STAPHYLEA TRIFOLIA L.

Fruiting specimens were collected on August 11 on the bank of the Chattahoochee River near Mill Port Landing, Decatur County (just about opposite the southeastern corner of Alabama), in latitude 31° (*no. 1926*). Altitude about 90 feet. The occurrence of this species here was quite a surprise, for it is principally confined to the mountains. The southernmost stations previously known for it were Germain's Island in Columbia County, in the Piedmont region, where I collected it in June, 1902, and the banks of the Chattahoochee in Quitman County, 60 miles north of the present station, where I saw it in October of the same year. In reaching its southern limit on the Chattahoochee River, *Staphylea trifolia* resembles the considerable number of Alleghanian species which extend down to River Junction, about 30 miles farther south. (See Chapman in Bot. Gaz. **10**: 254. 1885.)

TRIADENUM LONGIFOLIUM Small, Bull. Torrey Club **25**: 140, 141. 1898

Collected on September 5 in the muddy swamp of the Ocmulgee River in Bibb County about two miles below Macon (*no. 1971*). Intimately associated with *T. petiolatum*, which it much resembles; but the fact of their growing together without intergrading is pretty good evidence that these two species are distinct. *T. longifolium* was previously known only from the original specimens collected by Rugel in Alabama and Florida in 1843.

To found a new species on a dried specimen which has been accessible to botanists for over half a century is a practice not usually to be commended, but in this case the subsequent developments seem to have justified it.

VIOLA TRIPARTITA GLABERRIMA (Ging.) Harper

Rather common in rich shady woods in Randolph County (*no. 1881*). Although this is said to intergrade with *V. tripartita* in Alabama * and elsewhere, there is no such intergradation in Southwest Georgia, for the simple reason that *V. tripartita* does not grow there, or anywhere else in the coastal plain, as far as known. However, I am not prepared to raise the variety to specific rank.

Mr. Pollard has assumed † that *V. tripartita glaberrima* does not range south of Athens, Georgia, its place being taken farther south by his *V. tenuipes* (a species which I have not yet collected); which assumption was justifiable at that time, no specimens of var. *glaberrima* from South Georgia being then known.

* Mohr, Contr. U. S. Nat. Herb. **6**: 628. 1901. But Dr. Mohr's statement is inconsistent with other evidence on the same page, for he reports *V. tripartita* only from Lee County (but neither form is mentioned in Earle's later Flora of the Metamorphic Region) and the var. *glaberrima* only from Tuscaloosa County.

† Proc. Biol. Soc. Wash. **15**: 202. 1902.

Lythrum Curtissii Fernald, Bot. Gaz. **33**: 155. 1902

Not rare in the muddy swamp of Spring Creek near Colquitt, Miller County, Aug. 4 (*no. 1918*); also seen on the bank of the same creek near Brinson, Decatur County, eight days later. These two stations are almost in a direct line between the type-locality in Calhoun County and the other station (Aspalaga, Florida) mentioned in the original description.

This species is not mentioned in Koehne's recent monograph of the Lythraceae (Engler's Pflanzenreich, Heft 17. October, 1903).

Eryngium praealtum Gray, Bost. Jour. Nat. Hist. **6**: 210. 1850. (Pl. Lindh.)

This species has been united by Coulter and Rose with *E. aquaticum* L. (*E. virginianum* Lam.), but it is distinct, certainly varietally if not specifically. On June 18 I collected it for the first time, in the swamp of the Savannah River in the southeastern corner of Effingham County (*no. 1839*). It was not yet in flower, and probably did not begin to flower until July or August. The river was so high at the time* that the plants were about half submerged, and I had to use a boat to get them. My station is within 20 miles of Bluffton, S. C., where Dr. Mellichamp collected the same plant. There is also a specimen in the herbarium of the New York Botanical Garden collected by my friend Mr. M. H. Hopkins in a "marshy spot just below Savannah, Aug. 9, 1897." This station is about the same distance from the two just mentioned as they are from each other.

Dr. Gray's comparison of the leaves of this species to those of a *Rumex* is a very apt one. I mistook the plant for a *Rumex* myself until I saw its budding inflorescence.

Many if not most of the larger leaves bore an appendage the like of which I have never seen described, consisting of what was essentially a smaller leaf 2–6 cm. long, attached near the middle of the upper surface of the true leaf, with its ventral surface facing that of the leaf, its dorsal surface more or less concave, and its midrib adnate for most of its length to that of the leaf. This appendage was too common to be considered a mere monstrosity, but I will not attempt to explain it. I noticed that some insect

* See second footnote on page 149.

or spider had woven a dense web in some of the larger appendages, but this may not mean anything.

ERYNGIUM AROMATICUM Baldw.

In dry sand near Jesup, Wayne County, in flower, September 14 (*no. 1998.*) This extends its known range about 50 miles northward. I found this plant near the Florida line in Charlton and Clinch Counties in August, 1902, but before that it had been known only from Florida. *

The "*Eryngium foetidum* L." mentioned by Michaux and Pursh,† is in all probability *E. aromaticum*, which of course had not then been distinguished, though Michaux must have seen the plant on his travels in northeastern Florida, where it is often collected. Walter also mentioned an *E. foetidum*, the description of which sounds more like what we now call *E. virginianum* Lam. He of course never saw Baldwin's plant, for it does not grow in his territory.

ELLIOTTIA RACEMOSA Muhl.

Since reporting this species from Telfair County,‡ I have found still another station for it, about forty miles farther south, namely, in very dry pine-barrens just north of Douglas, Coffee County,

* In the Torrey Herbarium there is a specimen of it labeled "Near Fort King, Alabama. *Lt. Alden*, 1833", and by reason of this specimen it has been credited to Alabama in Coulter and Rose's *Revision* (1888) and *Monograph* (1900) of North American *Umbelliferae*, and in Small's *Flora of the Southeastern States* (1903). But this species is not mentioned in Dr. Mohr's *Plant Life of Alabama* (1901), and on investigating I find that the "Alabama" on the label must be a clerical error. Torrey and Gray were not misled by it, but it seems strange that they did not correct the label. Fort King is (or was) in Marion County, Florida, near the present city of Ocala, and a battle was fought there April 28, 1840, so it is extremely likely that this is the place where Lieut. Alden was stationed in 1833. Further evidence as to the field of Lieut. Alden's botanical operations is found in Torrey and Gray's *Flora of North America*. In the preface (p. xii) they say: "From Southern and Eastern Florida we have received interesting collections from . . . Lieut. ALDEN of the United States Army." (And this gentleman is not mentioned among their contributors from Alabama.) In the same volume under *Eryngium aromaticum* (page 604), they say: "Dry pine woods, East and Middle Florida, *Baldwin! Dr. Leavenworth! Mr. Alden!*" So we have no evidence that *E. aromaticum* grows within 140 miles of Alabama. Errors of this kind usually die hard, so I have gone into considerable detail in order to suppress this one.

† See C. & R. Rev. N. Am. Umbell. 99. 1888; Contr. U. S. Nat. Herb. 7: 250. 1900.

‡ Torreya 3: 106. 1903.

where I collected it on the morning of September 22, long past flowering (*no. 2011*).* None of the plants were over three or four feet tall. *Elliottia* is a very ordinary-looking bush when not in flower, and might easily be mistaken for something else, particularly for *Diospyros virginiana*, a small form of which sometimes grows in similar situations.

AZALEA CANDIDA Small

Seen only on outcrops of Altamaha Grit, in Tattnall County, June 24 (*no. 1858*) and 26, and in the northeastern corner of Coffee County, September 11. Previously reported only from the type-locality in Lowndes County, but on what formation is not known. At the time I collected it, it was long past flowering; † and the flowers are not yet known, except from a few shrivelled fragments on the type-specimens, which were collected at about the same time of year as mine. This species is probably nearest related to *A. canescens* Mx.

DICERANDRA ODORATISSIMA Harper

Noticed on the sand-hills of the Altamaha River in Liberty County, September 14. Here the corollas were often slightly tinged with pink, making an approach in this respect to the other species of the genus. Captain LeConte's specimen (mentioned in my original description) ‡ may have come from near this place.

PENTSTEMON DISSECTUS Ell.

After having been lost to science for seventy years or so, this species was collected on outcrops of Altamaha Grit near the Ohoopee River in Tattnall County on June 24, in fruit (*no. 1856*), and seen in similar situations in Dooly County on August 29. It has a rather interesting history. It was described by Elliott from specimens sent "from Louisville, Georgia," by James Jackson, § but

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* On May 11, 1904, I revisited this spot and found that it had just been burned over and the *Elliottia* completely denuded, but most of the specimens were putting out new leaves again.

† On April 26, 1904, I revisited the spot, and it was just past flowering then.

‡ Bull. Torrey Club **28**: 479. 1901.

§ This James Jackson, afterward a professor in the University of Georgia, seems to have been a son of the General James Jackson who was governor of Georgia from 1798 to 1801, at which time Louisville was the capital of the state.

it is not likely that the specimens were collected close to Louisville, for Mr. M. H. Hopkins, a very observant botanist who has lived in Louisville for years and is familiar with the surrounding country, tells me that he has never seen this plant. But the Altamaha Grit country comes within fifteen miles of Louisville, and if there are any rock outcrops in that part of it, it may have been on one of them that Mr. Jackson found the *Pentstemon.* It was a common practice in Elliott's time (and continues to some extent to the present day, unfortunately) for authors to cite as localities for their specimens merely the nearest town, or the place from which they were sent.

Croom* has published the following note on this species: "Abundant in wet Pine woods, between the Oakmulgee and Oconee Rivers,† Georgia. Flowers in May." His statement that it grows in wet places is rather puzzling (unless perhaps he saw it in rainy weather, when everything was wet), for I find it on dry rocks.‡ And I do not quite understand its being abundant, or growing so far inland.

The fruit of *Pentstemon dissectus* has never been described, but it does not differ noticeably from that of *P. hirsutus* (the common species in Georgia).

UTRICULARIA RESUPINATA B. D. Greene

On the miry margin of a large shallow grassy pine-barren pond in the lime-sink region of Decatur County about two miles southwest of Donalsonville, August 11 (*no. 1925*). Not previously reported from Georgia, or from any other southern state except Florida.

STOKESIA LAEVIS (Hill) Greene

This species has the reputation of being rare, therefore the announcement of a station for it in Georgia may be of interest. On September 9 I collected it in moist pine-barrens in Dodge County near Suomi, in the Altamaha Grit region (*no. 1980*). It was already past flowering.

* Am. Jour. Sci. 25 : 76. 1834.

† Doubtless somewhere between the modern cities of Dublin and Hawkinsville, through or near which points Croom is known to have passed.

‡ The same discrepancy exists between the type-habitat and present known habitat of *Gerardia Plukenetii* Ell. See Mohr, Contr. U. S. Nat. Herb. 6 : 727. 1901.

CARPHEPHORUS TOMENTOSUS (Michx.) T. & G.

This species seems to have such a limited distribution in Georgia that a few stations for it may be worth mentioning. I have seen it only in rather dry nearly flat pine-barrens in the lower part of the Altahama Grit region or between that and the coast, in the counties of Appling, Wayne and Pierce. In September, when it was in flower, I saw it at the following places. In Appling: near Prentiss (*no. 1993*), and between Southern Pines and Hurst (two stations on the B. & B. R. R.); in Wayne: near Hortense and Nahunta; and in Pierce, between Offerman and Bristol.

CHONDROPHORA VIRGATA (Nutt.) Greene, Erythea **3**: 91. 1895

This little known species has an interesting and rather anomalous distribution and somewhat of a history. The only definite stations for it now on record are in the mountains of Alabama, on Carboniferous sandstone. Its occurrence there has been described or discussed by Mohr,* Kearney † and Harbison ‡; and I have seen an immature specimen collected somewhere in the same region by Eggert. In 1903 I met with it quite unexpectedly in Georgia, two or three hundred miles from the Alabama localities and in very different surroundings from those previously described, but associated with a few of the same species which are said to accompany it in Alabama. I found it only on outcrops of Altamaha Grit, in Tattnall (*no. 1857*) and Dooly (*no. 1855*) counties. At the latter station *C. nudata* (which is very abundant in almost all moist pine-barrens) was growing only a few yards away, but the two species were perfectly distinct, though flowering at the same time. There can be little doubt of the identity of my specimens with those from Alabama, but whether any of these are the same as Nuttall's type is another question, as Dr. Mohr pointed out.

CHRYSOMA PAUCIFLOSCULOSA (Michx.) Greene, Erythea **3**: 8. 1895

This, usually considered a sea-beach plant,§ also occurs some distance in the interior. On September 10 I found it at two

* Bull. Torrey Club **24**: 28. 1897; Contr. U. S. Nat. Herb. **6**: 79, 771. 1901.
† Science II. **12**: 833. 30 N 1900.
‡ Biltmore Bot. Stud. **1**: 153. 1902.
§ See Lloyd, Bull. Torrey Club **28**: 445–450. 1901.

places on the western border of Montgomery County, on the sand-hills of Gum Swamp Creek (*no. 1986*) and its continuation, the Little Ocmulgee River. The bushes were about a meter tall, and just beginning to flower. In the Torrey Herbarium there is a specimen collected by Croom still farther inland, on the sand-hills of Brier Creek, Georgia (doubtless on the Augusta-Louisville road, near where Richmond, Burke and Jefferson counties meet), and it is mentioned in some of Croom's letters to Torrey.

ASTER ERYNGIIFOLIUS T. &. G. Fl. N. Am. **2**: 502. 1843

Prionopsis Chapmanii T. & G. Fl. N. Am. **2**: 245. 1842. Not *Aster Chapmanii* T. & G. Fl. N. Am. **2**: 161. 1841.

In moist undulating pine-barrens about a mile east of Recovery, Decatur County, August 14 (*no. 1932*); so rare that I could find only two or three good specimens. This locality is near the extreme southwest end of the Altamaha Grit region. The species has been previously reported only from Florida, but on what formation it is of course not stated.

ANTENNARIA SOLITARIA Rydb.

Abundant at one place in rich shady woods near Cuthbert, July 28 (*no. 1903*). This is the only station known for it in the coastal plain, with the exception of Carpenter's original station in Louisiana,* which probably has not been rediscovered. *A. plantaginifolia*, which I have also never seen farther south, grows in drier places in the same woods.

ACANTHOSPERMUM HISPIDUM DC. Prodr. **5**: 522. 1836

Rather abundant in waste places along the river road in the outskirts of Darien, Sept. 16 (*no. 1999*). A native of South America, not previously reported from the United States. It has a very different aspect from its now too common congener *A. australe*, being an erect bushy plant sometimes a meter tall and wide.

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* T. & G. Fl. N. A. **2**: 431. 1843. What part of Louisiana is not specified, but a note in Carpenter's handwriting, accompanying the specimen in the Torrey Herbarium, says: "Sides of steep hills, near Jackson, La. Feby. 10th." Jackson (or at least the modern settlement of that name) is in East Feliciana Parish, considerably nearer the coast and farther south than my station, and hundreds of miles from any other known.

A specimen labeled "Ballast ground, Pensacola, Florida," collected by A. H. Curtiss, August 2, 1899 (*no. 6501*, distributed as *A. humile* DC.) is identical with my plant.

HELIANTHUS HETEROPHYLLUS Nutt.

This seems to be quite rare in Georgia. I saw it in September in rather dry pine-barrens near Jesup and Offerman, but not in sufficient quantity to collect.

BALDWINIA ATROPURPUREA Harper

Principally confined to the Altamaha Grit region, but seen also in September, 1903, in the nearly flat pine-barrens of Wayne and Pierce counties, where the Grit may possibly be overlaid by some newer formation. In Wayne County it is quite common, and I secured excellent specimens near Nahunta on the 19th (*no. 2007*). A few days later I found it in two additional counties well within the Grit region, namely, Coffee and Wilcox. Traveling from Douglas to Cordele on the 23d, a distance of about 65 miles through the Altamaha Grit region, I noted this plant seventeen times, between different mile-posts, in four counties. (That such a common, conspicuous and unmistakable plant should have been overlooked until the end of the 19th century is a striking illustration of how little the interior of South Georgia has been explored by botanists.*)

MARSHALLIA RAMOSA Beadle & F. E. Boynton

This recently-described species seems to have considerable variation in habitat. It was discovered in 1900 "in moist, sandy pine-lands at [or near?] Eastman, Georgia." In 1902 I found it in dry pine-barrens in Johnson County,† and in 1903 I found it only on outcrops of Altamaha Grit, in Tattnall (*no. 1855*) and Dodge counties. The latter station is only a couple of miles from Eastman, and therefore somewhere near the type-locality.

MESADENIA DIVERSIFOLIA (T. & G.) Greene

Cacalia diversifolia T. & G. Fl. N. Am. **2**: 435. 1843; Chapm. Fl. S. States 244. 1860. Type-locality (according to Dr. Chapman, the discoverer): "Muddy banks of the Chipola River, [near?] Marianna, West Florida."

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* But that part of the railroad from which these seventeen observations were made did not exist in the summer of 1900, when the species was discovered.

† See Bull. Torrey Club **31**: 27. 1904.

Mesadenia difformis Small, Fl. S. E. States 1301. 1903.
Type-locality: Walton County, Florida. (Collected by Curtiss in 1885.)

When I was assisting Dr. Small in preparing a key to *Mesadenia* for his Flora we could find no specimen of *M. diversifolia*, and came very near omitting this species entirely as being too little known. The original specimens, collected by Chapman, must have been lost, as the material so labeled in the Torrey Herbarium represents something very different, and inquiry at the Gray Herbarium failed to reveal anything corresponding to the original description.

But within two weeks after the book was given to the public I unexpectedly received a great deal of new light on the subject. On August 4 I found specimens agreeing exactly with Chapman's description (as far as it goes) in the muddy swamps of Spring Creek at two different places: in Early County near Damascus (*no. 1914*) and in Miller County near Colquitt (*no. 1917*.) A couple of months later I saw in the Biltmore Herbarium a good specimen collected on the muddy banks of the Chipola River near Marianna, Florida (the type-locality, apparently), by C. L. Boynton, August 31, 1899.

One important character can now be added to the descriptions of this species; viz., the involucral bracts have winged keels, as in *M. tuberosa*, *M. Floridana*, and *M. sulcata*. *M. diversifolia* differs from these three species, however, in having the stem merely angled, not furrowed (just as Dr. Chapman indicated), as well as in the lobed upper leaves and in habitat.

M. difformis Small, based on a single immature specimen collected in Walton County, Florida, by A. H. Curtiss in 1885, now proves to be merely a young state of *M. diversifolia*, and must be relegated to synonymy.

As now understood, *Mesadenia diversifolia* has a very restricted range, being known only from Early and Miller counties in Georgia and Jackson and Walton counties in Florida, all of which are wholly or partly in the Lower Oligocene or lime-sink region. It is also to be expected in the intervening counties of Decatur in Georgia and Houston in Alabama.

COLLEGE POINT, NEW YORK.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Arthur, J. C. Amphispores of the grass and sedge rusts. Bull. Torrey Club **32**: 35–41. *f. 1–9.* 23 F 1905.

With a description of *Puccinia Garrettii* sp. nov.

Arthur, J. C. Terminology of the spore-structures in the *Uredinales.* Bot. Gaz. **39**: 219–222. 20 Mr 1905.

Balfour, I. B. Physiological drought in relation to gardening. Plant World **8**: 1–5. [F] 1905.

Barnes, C. R. The theory of respiration. Bot. Gaz. **39**: 81–98. 17 F 1905.

Bartlett, G. H. *Arenaria macrophylla* in Connecticut. Rhodora **7**: 20. 26 Ja 1905.

Beattie, F. S. Remarks on Rhode Island plants. Rhodora **7**: 39, 40. 26 F 1905.

Berry, E. W. Additions to the fossil flora from Cliffwood, New Jersey. Bull. Torrey Club **32**: 43–48. *pl. 1, 2.* 23 F 1905.

With new species in *Microzamia*, *Myrica*, *Eucalyptus*, *Phyllites* and *Carpolithus* (2).

Berry, E. W. A palm from the Mid-Cretaceous. Torreya **5**: 30–33. *f. 1, 2.* 28 F 1905.

Flabellaria magothiensis sp. nov.

Brackett, M. M. A summer in the tropics. Plant World **8**: 6–12. *f. 1–3.* [F]; 29–31. *f. 11.* [Mr] 1905.

Brainerd, E. Notes on New England violets, — II. Rhodora **7**: 1–8. 26 Ja 1905.

Including a key to the blue acaulescent violets of the northeastern United States.

Britton, N. L. *Carex Underwoodii* sp. nov. Torreya **5**: 10, 11. 19 Ja 1905.

Native of Jamaica.

Britton, N. L. *Galactia Curtissii* sp. nov. Torreya **5**: 33, 34. 28 F 1905.

Native of the Isle of Pines.

Britton, N. L. *Jacquinia Curtissii* sp. nov. Torreya **5**: 44. 22 Mr 1905.

Native of the Isle of Pines.

Chamberlain, C. J. Alternation of generations in animals from a botanical standpoint. Bot. Gaz. **39**: 137–144. *f. 1, 2.* 17 F 1905.

Churchill, J. R. Preliminary lists of New England plants, — XVII. Rhodora **7**: 33–38. 26 F 1905.

Scrophulariaceae and *Verbenaceae.*

Clark, A. G. White form of *Sabbatia chloroides.* Rhodora **7**: 38, 39. 26 F 1905.

Clendenin, I. Other freaks of peas. Torreya **5**: 41, 42. *f. A–C.* 22 Mr 1905.

Clendenin, I. Twin pine embryos. Torreya **5**: 11. 19 Ja 1905. [Illust.]

Cockerell, T. D. A. New binomials in an index. Torreya **5**: 44, 45. 22 Mr 1905.

Coulter, J. M. & Land, W. J. G. Gametophytes and embryo of *Torreya taxifolia.* Bot. Gaz. **39**: 161–178. *pl. A, 1–3.* 20 Mr 1905.

Davis, B. M. Fertilization in the *Saprolegniales.* Bot. Gaz. **39**: 61–64. 20 Ja 1905.

Davis, B. M. The sexual organs and sporophyte generation in the *Rhodophyceae.* Bot. Gaz. **39**: 64–66. 20 Ja 1905.

DeVries, H. A new conception concerning the origin of species. Harper's Monthly Magazine **110**: 209–213. Ja 1905.

DeVries, H. Species and varieties: their origin by mutation. i–xviii. 1–847. Chicago, 1905.

MacDougal, D. T. Discontinuous variation and the origin of species. Torreya **5**: 1–6. 19 Ja 1905.

MacDougal, D. T. Studies in organic evolution. Jour. N. Y. Bot. Gard. **6**: 27–36. *f. 8–13.* F 1905.

MacDougal, D. T. *and others.* Mutants and hybrids of the oenotheras. 1–57. *pl. 1–22* + *f. 1–13.* Washington, D. C., 1905.

Carnegie Inst. Wash. Publ. No. 24.

Mansfield, C. M. A curious white oak. Plant World **8**: 17. [F] 1905.

Maxon, W. R. On the names of three Jamaican species of *Polypodium.* Bull. Torrey Club **32**: 73–75. 22 Mr 1905.

Maxon, W. R. A new *Asplenium* from Mexico. Bull. Torrey Club **31**: 657, 658. 9 Ja 1905. [Illust.]

A. modestum sp. nov.

Murrill, W. A. A key to the stipitate *Polyporaceae* of temperate North America — I. Torreya **5**: 28–30. 28 F 1905; — II. Torreya **5**: 43, 44. 22 Mr 1905.

Murrill, W. A. The *Polyporaceae* of North America — X. *Agaricus, Lenzites, Cerrena,* and *Favolus.* Bull. Torrey Club **32**: 83–103. 22 Mr 1905.

Includes *Agaricus juniperinus* sp. nov.

Nash, G. V. Botanical exploration of the Inagua Islands, Bahamas. Jour. N. Y. Bot. Gard. **6**: 1–19. *f. 1–7.* Ja 1905.

Nash, G. V. The flowering of *Nolina texana.* Jour. N. Y. Bot. Gard. **6**: 48–50. *f. 16.* Mr 1905.

Nash, G. V. A *Paspalum* new to the West Indies. Torreya **5**: 6–9. 19 Ja 1905.

Olive, E. W. The morphology of *Monascus purpureus.* Bot. Gaz. **9**: 56–60. 20 Ja 1905.

Olsson-Seffer, P. The principles of phytogeographic nomenclature. Bot. Gaz. **39**: 179–193. 20 Mr 1905.

Pammel, L. H. Notes on some plants of northeastern Iowa. Plant World **8**: 31–35. *f. 12, 13.* [Mr] 1905.

Peck, C. H. New species of fungi. Bull. Torrey Club **32**: 77–81. 22 Mr 1905.

Descriptions of twelve new species in 11 genera.

Peirce, G. J. The dissemination and germination of *Arceuthobium occidentale* Eng. Ann. Bot. **19**: 99–113. *pl. 3, 4.* Ja 1905.

Robinson, B. L. A Connecticut station for *Lycopodium Selago.* Rhodora **7**: 20. 26 Ja 1905.

Rydberg, P. A. Studies on the Rocky Mountain flora — XIII. Bull. Torrey Club **31**: 631–655. 9 Ja 1905.
With descriptions of 59 new species and varieties in 23 genera.

Safford, W. E. Extracts from the note-book of a naturalist on the island of Guam—XXV. Plant World **7**: 285–298. *pl. 17.* [Ja 1905.]

Schneck, J. Fasciation in the cherry. Plant World **8**: 35, 36. *f. 14.* [Mr] 1905.

Schumann, K. & Gürke, M. Blühende Kakteen (Iconographia *Cactacearum*). 15: *pl. 57–60.* 1 Ja 1905.

Shull, G. H. Galtonian regression in the "pure line." Torreya **5**: 21–25. 28 F 1905.

Spalding, E. S. Mechanical adjustment of the suaharo (*Cereus giganteus*) to varying quantities of stored water. Bull. Torrey Club **32**: 57–68. *pl. 3, 4* + *f. 1–9.* 22 Mr 1905.

Spalding, V. M. Soil water in relation to transpiration. Torreya **5**: 25–27. 28 F 1905.

Sumstine, D. R. *Panaeolus acidus* sp. nov. Torreya **5**: 34. 28 F 1905.

True, R. H. & Oglevee, C. S. The effect of the presence of insoluble substances on the toxic action of poisons. Bot. Gaz. **39**: 1–21. *f. 1, 2.* 20 Ja 1905.

Underwood, L. M. The early writers on ferns and their collections — IV. Presl, 1794–1852; John Smith, 1798–1888; Fée, 1789–1874; and Moore, 1821–1887. Torreya **5**: 37–41. 22 Mr 1905.

Underwood, L. M. A glimpse at early botanical literature. Plant World **8**: 25–29. *f. 9, 10.* [Mr] 1905.

Vail, A. M. *Onagra grandiflora* (Ait.) a species to be included in the North American flora. Torreya **5**: 9, 10. 19 Ja 1905.

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Underwood, L. M. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

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Small, J. K. & Vail, A. M. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 92–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

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BULLETIN

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TORREY BOTANICAL CLUB

APRIL, 1905

New or noteworthy Hepaticae from Florida

Alexander W. Evans

(With plate 5)

The following notes are based almost entirely on three collections of *Hepaticae* from southern Florida, recently made under the direction of the New York Botanical Garden. The majority of the specimens were gathered in the region south of Miami. Dr. Small has already called attention to the physiographic peculiarities of this district and has commented upon the intimate relationship which exists between the higher plants found there and those native to the West Indies.* The *Hepaticae* bring out the same relationship; more than half the species in the collection have also been found in the West Indies or in other parts of tropical America, and the others find their closest allies among species from these regions.

The collections embrace only twenty-one species in a condition to be identified; three of these, however, are apparently undescribed, and six of the others are here definitely recorded for the first time from the United States. Nine species, therefore, are new to our hepatic flora. The remaining species, all of which have previously been collected in Florida, include one *Riccardia* (*R. pinguis*), one *Plagiochila* (*P. ludoviciana*), one *Radula* (*R. australis*), seven *Lejeuneae* (*Microlejeunea lucens*, *Lejeunea americana*, *Cheilolejeunea phyllobola*, *Euosmolejeunea duriuscula*, *E. opaca*, *Brachiolejeunea corticalis*, and *Mastigolejeunea auriculata*) and two species of *Frullania* (*F. Kunzei* and *F. caroliniana*). The additions to

* Jour. N. Y. Bot. Gard. **5**: 49–53. 1904.

[The Bulletin for March (**32**: 123–177) was issued 19 Ap 1905.]

our flora include two representatives of the *Epigonianthcae* and seven *Lejeuneae;* they are as follows:

1. **Plagiochila Smallii** sp. nov.

Bright- or dark-green, loosely tufted: stems rigid, varying in color from green to yellowish or reddish, 0.35 mm. in diameter, composed of about three layers of thick-walled cells around a central cylinder of thin-walled, colorless cells, all the cells except those of the outermost layer more or less elongated; stems sparingly and irregularly or subdichotomously branched, the branches oblique, similar to the stem but often with smaller leaves: stem-leaves distant, spreading at an angle of 45–60°, narrowly ovate to ligulate, maximum length about 3 mm., width about 1 mm., shortly decurrent both antically and postically; antical margin straight or nearly so, plane or narrowly revolute, especially near the base, entire or with one or two small teeth in outer part; postical margin straight and parallel with the antical margin or slightly curved, revolute near the base, bearing two to six teeth in outer third, otherwise entire; apex broad and usually truncate, bearing two to four teeth; all of the teeth acuminate, the largest (in the apical region) six to ten cells long, three to seven cells wide at the base, and ending in a row of two or three cells: branch-leaves similar to the stem-leaves but usually with fewer and smaller teeth: leaf-cells plane, averaging $29 \times 16\,\mu$ at the margin of the leaf, $37 \times 23\,\mu$ in the middle, and $46 \times 25\,\mu$ at the base; cell-walls thin but with distinct triangular trigones and occasional intermediate thickenings; cuticle slightly thickened, smooth: underleaves rudimentary: inflorescence dioicous: ♀ inflorescence borne on a more or less elongated branch, usually without an innovation; bracts in one pair, similar to the stem-leaves but usually a little broader in the basal region and with a few more teeth along the postical margin, 2.5 mm. long, 1.2 mm. wide; perianth (of unfertilized inflorescences) somewhat compressed, campanulate, 1.2 mm. long, 1 mm. wide, shortly bilabiate at the mouth, each lip bearing about twenty slender teeth, the majority of them being six to twelve cells long and two cells wide at the base; wing along the antical keel entire and very narrow, found in the basal region only: ♂ inflorescence and mature sporophyte not seen. (PLATE 5, FIGURES 1–8.)

In hammocks near the homestead trail, between Cutler and Camp Longview (*Small & Carter 1376, 1411*). In everglades near the unfinished railroad grade, between Cocoanut Grove and Cutler (*Small & Carter 1388*). Breckell's Hammock (*E. G. Brit-*

ton 87). In everglades near Camp Longview (*Small & Wilson 1520*). *No. 1411* may be designated the type.

The leaf-cells of *P. Smallii* are somewhat variable with respect to the size of their trigones; even when very small, however, these structures can be easily demonstrated in leaves which are spread out flat. In some specimens the trigones and intermediate thickenings are more or less confluent, and this is especially likely to be the case along the inner side of the marginal cells, where the walls often present the appearance of being uniformly thickened (FIGURE 5).

As one would naturally expect, the species has several allies among the numerous species of *Plagiochila* found in the West Indies. Apparently the closest of these is *P. diffusa* Steph.,* a Cuban plant collected by Wright and distributed in his *Hepaticae Cubenses*. This species, however, is smaller and more delicate than *P. Smallii*, its leaves are shorter and relatively broader, the margins being more curved, the trigones of the leaf-cells are commonly indistinct, and the spine-like teeth at the mouth of the perianth are shorter. The insertion of the leaves in *P. diffusa* is very much the same as in *P. Smallii*; the line of insertion is sharply arched as in the majority of the *Plagiochilae*, and the leaves are consequently shortly but distinctly decurrent on both sides: Stephani's description would hardly indicate that this was the case.

Among other related species the following may be especially mentioned: *P. Wrightii* Steph.,† *P. tamariscina* Steph.‡ and *P. tenuis* Lindenb.§ The first of these is known from Cuba only; the second has been found in several of the West Indian islands; the third is still more widely distributed, its range extending into South America. In *P. Wrightii* the leaves are relatively broader than in *P. Smallii* and are rounded rather than truncate at the apex, a difference to be seen especially well in the perichaetial bracts. The inflorescence is almost always subtended by an innovation, and the bracts are crowded and in several pairs. *P.*

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* Bull. Herb. Boissier II. 2: 870. 1902.

† *L. c.* 681.

‡ *L. c.* 685.

§ Sp. Hepat. Plagioch. 50. *pl. 10.* 1841.

tamariscina is smaller and more irregularly branched than the Florida species, but agrees with it in being without a subfloral innovation. The leaves of *P. tamariscina* are relatively broader and their marginal teeth, although smaller, are usually more numerous. The leaf-cells are variable; in typical cases the walls are uniformly thickened through the coalescence of trigones, but in some cases the trigones are distinct, and in still others the walls are thin throughout. In *P. tenuis* the ♀ inflorescence bears a subfloral innovation which is itself often floriferous; the leaves have fewer teeth than in *P. Smallii*, and the leaf-cells have larger and more frequently confluent trigones, which are especially conspicuous in the perianth and bracts.

2. LOPHOCOLEA MARTIANA Nees, in G. L. & N. Syn. Hep. 152. 1845.

Jungermannia connata Nees, in Martius, Fl. Bras. **1**[1]: 332. 1833; Ic. Plant. Crypt. 32. *pl. 17, f. 2.* 1828–1834. Not *Jungermannia connata* Swartz, Prodr. Fl. Ind. Occid. 143. 1788 (= *Lophocolea connata* Swartz & Nees, in G. L. & N. Syn. Hep. 153. 1845).

Blanton (*L. M. Underwood 228*). Everglades west of Miami (*Small & Nash 480*). In the hammocks near the homestead trail, between Cutler and Camp Longview (*Small & Carter 1355 p. p., 1371 p. p., 1396*). Widely distributed in the American tropics.

Lophocolea Martiana is fully described by Nees von Esenbeck in the *Synopsis Hepaticarum*, and also, more recently, by Spruce.* Both descriptions are drawn from robust and typical specimens and give an excellent idea of the plant as it usually appears. In some respects, however, the species is more variable than these descriptions would indicate. The leaves, for example, are approximately rather than truly opposite. At their antical bases they never quite correspond and are consequently never connate; at their postical bases they are either connate with the corresponding quadrifid underleaf or are connected with it by means of short and narrow wings; in this region the leaves are in some cases exactly opposite; but in other cases one of the two leaves will be much farther away from the underleaf than the

* Hep. Amaz. et And. 430. 1885.

other, making them appear distinctly alternate, and under these circumstances the wing may become exceedingly narrow or even obsolete. On a typical leaf the apex is broadly and more or less obliquely truncate and bears at each angle a sharp and slender tooth, the teeth usually diverging from each other. On a poorly developed leaf the teeth are often much less divergent or even subparallel and include between them a lunulate to acute sinus; on such a leaf the teeth are larger than on a typical leaf, and the postical tooth is appreciably larger than the antical.

The true *Lophocolea connata*, with which *L. Martiana* was originally confused, is also widely distributed in the American tropics and may perhaps be expected in southern Florida. It is distinguished by its bifid underleaves and by its less spinose bracts and bracteoles. Both species are autoicous.

3. DIPLASIOLEJEUNEA UNIDENTATA (Lehm. & Lindenb.) Schiffn. Bot. Jahrb. **23**: 583. 1897.

Jungermannia unidentata Lehm. & Lindenb. in Lehmann, Pug. Plant. **6**: 48. 1834.

Lejeunea unidentata Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba **9**: 478. *pl. 19. f. 2.* 1845.

Lejeunea (*Diplasio-Lejeunea*) *unidentata* Steph. Hedwigia **29**: 90. 1890.

In hammocks near the homestead trail, near Camp Longview (*Small & Wilson*, mixed with *2058*). Widely distributed in the West Indies.

The genus *Diplasiolejeunea* has not before been reported from the United States. It is distinguished from all the other genera of the *Lejeuneae* (except *Colurolejeunea*) by the possession of double the usual number of underleaves; in other words, this genus develops one underleaf for every leaf instead of for every pair of leaves. The underleaves are inserted on the axis at approximately the same level as the corresponding leaves. Aside from the duplication of the underleaves the genus is closely related to *Cololejeunea*, the lobules being built up on essentially the same plan.

In *D. unidentata* the leaves are destitute of hyaline margins and the lobe is orbicular or broadly ovate in outline. The leaf-cells are either plane or slightly convex. The lobule is inflated except along the free margin, which is more or less appressed to the lobe. Two marginal teeth in the outer half of the lobule may usually be discerned. The inner tooth when normally developed points outward and consists of a row of two or three cells. The outer tooth, situated midway between the inner tooth and the end of the keel, is much larger and is apparently accountable for the specific name. This tooth points forward and is normally subulate in shape, averaging perhaps eight cells long and two cells wide in the lower half; it is, however, subject to a good deal of variation in size and shape and sometimes bears a short secondary tooth near the base. The underleaves are bifid to beyond the middle, and their straight divisions spread widely and are obtuse or subacute at the apex. *D. unidentata* is usually found on the bark of trees. According to Spruce * it is scarcely distinct from *D. pellucida* (Meissn.) Schiffn., which also has a wide distribution in tropical America. This latter species, however, is epiphyllous in habit and the lobes of its leaves are usually hyaline-margined.

4. **Cololejeunea diaphana** sp. nov.

Bright- or pale-green, scattered or very loosely cespitose, often mixed with other *Lejeuneae:* stems prostrate and closely adherent to the substratum, 0.035 mm. in diameter, sparingly and irregularly branched, the branches widely spreading: leaves distant, obliquely to widely spreading, the lobe ovate to lanceolate, 0.25 mm. long, 0.15 mm. wide, attached by a very short and almost transverse line of insertion, scarcely falcate, postical margin straight or somewhat curved, forming a continuous line with the keel, antical margin more strongly curved, apex acute to subobtuse, usually tipped with a single cell, margin varying from entire to slightly crenulate or denticulate from projecting cells; lobule (when well-developed) inflated, ovoid to obovoid, 0.1 mm. long, 0.07 mm. wide, keel slightly arched, free margin curved, involute toward the base, tipped at the apex with a rounded cell and bearing a short blunt tooth midway between the apex and the end of the keel; stylus reduced to a single papilla; leaf-cells plane or nearly so, averaging 13 μ at the margin, 18 × 13 μ in the middle and 30 × 16 μ at the base, thin-walled throughout or with very minute trigones: inflorescence autoicous: ♀ inflorescence sometimes on a short branch, sometimes on a leading branch, innovating on one side, the innovation sterile or again floriferous; bracts erect-spread-

* Hep. Amaz. et And. 302. 1884.

ing, more widely spreading after fertilization, complicate, the lobe narrowly oblong to lanceolate, 0.28 mm. long, 0.08 mm. wide, rounded to acute at the apex, margin as in the leaves, lobule oblong to cuneate, 0.12 mm. long, 0.035 mm. wide, apex mostly broad and obtuse, margin entire, or irregularly denticulate in apical region; perianth (immature) broadly obovate, 0.18 mm. long, 0.16 mm. wide, somewhat flattened, antical face plane, postical face with a broad and rounded keel, apex broad and truncate with a short beak, lateral keels sharp, denticulate from projecting cells, surface of perianth otherwise smooth or indistinctly roughened along the postical keel: ♂ inflorescence occupying a short branch or terminal on a longer branch; bracts distant to subimbricated, in one to six pairs, the lobe suberect, lanceolate, acute, 0.13 mm. long, 0.06 mm. wide, margin as in the leaves, lobule slightly concave, obovate, bluntly pointed, 0.08 mm. long, 0.05 mm. wide, entire or indistinctly denticulate; antheridia solitary: mature sporophyte not seen. (PLATE 5, FIGURES 9–14.)

In hammocks near the homestead trail, between Cutler and Camp Longview (*Small & Carter 1365 p. p., 1370 p. p.*). *No. 1365* may be designated the type.

C. diaphana is smaller and much more delicate than any of the other species of *Cololejeunea* known from the United States. The only one which it at all resembles is *C. Biddlecomiae* (Aust.) Evans,* in which also the leaves are more or less narrowed toward the apex and often acute. But in *C. Biddlecomiae* the whole outer surface of the lobe is roughened from projecting cells, there is a long stylus at the base of the lobule, and the roughened perianth is sharply five-keeled.

Among the tropical species, *Lejeunea* (*Colo-Lejeunea*) *ensifolia* Spruce,† an epiphyllous plant found in the Amazon region, is closely related to *C. diaphana*, but differs in its longer and more sharply pointed leaves, which are furthermore falcate and hamate. The variety *pigmaea* of this species, which, as Spruce implies, may be worthy of specific rank, has broader leaves than the type but is distinguished from *C. diaphana* by its five-keeled perianth, the keels projecting upward as short and rounded horns.

5. **Lejeunea floridana** sp. nov.

Bright- or pale-green, growing in depressed tufts, often mixed with other hepatics: stems prostrate, 0.14 mm. in diameter,

* Mem. Torrey Club 7: 168. 1902.

† Hep. Amaz. et And. 297. 1884.

irregularly branched, the branches obliquely to widely spreading, not microphyllous but usually with somewhat smaller leaves than the stem; rhizoids numerous, springing from the underleaves: leaves contiguous to loosely imbricated, the lobe widely spreading, ovate, 0.7 mm. long, 0.5 mm. wide, attached by a long and almost longitudinal line of insertion, antical margin straight or slightly curved near base, then more strongly curved to apex, postical margin less strongly curved, apex mostly broad and rounded, very rarely obtusely pointed, margin subentire or slightly and irregularly crenulate from projecting cells; lobule often obsolete, when well-developed inflated, triangular-ovoid, 0.12 mm. long, 0.09 mm. wide, keel slightly arched, roughened from projecting cells, free margin involute to apex, then passing by a long and shallow sinus to end of keel, apex tipped with a single, very blunt cell bearing a hyaline papilla at its proximal base; cells of lobe plane or somewhat convex, averaging 20 μ at the margin and $33 \times 25\ \mu$ in the middle and at the base, thin-walled throughout or with very minute trigones: underleaves distant, plane, orbicular, 0.2 mm. long, somewhat narrowed toward the base, bifid about one third with broad, triangular, rounded or obtuse lobes and a narrow sinus; margin very slightly crenulate from projecting cells; radicelliferous region bounded on each side by a large cell, sometimes developing a rudimentary disc: inflorescence autoicous: ♀ inflorescence borne on a leading branch or on a short branch, innovating on one side, the innovation sterile or again floriferous; bracts obliquely spreading, slightly complicate, the lobe oblong to ovate, 0.8 mm. long, 0.35 mm. wide, rounded to subacute at the apex, margin as in the leaves, lobule narrowly oblong, 0.25 mm. long, 0.04 mm. wide, scarcely projecting beyond end of keel, blunt, entire; bracteole slightly connate on both sides with bracts, ovate to obovate, 0.45 mm. long, 0.35 mm. wide, bifid about one tenth with broad, rounded or obtuse divisions and an obtuse sinus, margin as in the leaves; perianth slightly or not at all exserted beyond the bracts, obovoid, 0.7 mm. long, 0.4 mm. in diameter, narrowed toward the base, broad at the apex and with a distinct ciliolate beak, terete below, sharply five-keeled in upper third, the keels crenulate from projecting cells and extending upward as short rounded processes, surface otherwise smooth or nearly so: ♂ inflorescence occupying a short branch; bracts in two to ten pairs, imbricated and strongly inflated, 0.17 mm. long, 0.1 mm. wide, shortly bifid with obtuse divisions, the lobule slightly smaller than the lobe; antheridia solitary or in pairs; bracteoles at base of spike only, rotund and shortly bifid: mature sporophyte not seen. (PLATE 5, FIGURES 15-21.)

In hammocks near the homestead trail, between Cutler and

Camp Longview (*Small & Carter 1355 p. p., 1365 p. p.*). *No. 1355* may be designated the type. It is possible that the sterile specimens collected by Underwood at Ocala, Florida, in January, 1891, and distributed in *Hep. Amer. 178* (as *Lejeunea serpyllifolia*) should be referred to this species, but they are in too poorly developed a condition for positive determination.

One of the closest allies of *L. floridana* is *L. quinqueumbonata* Spruce,* which is known from the region of the Amazon. In both species the perianths are five-keeled in the upper part only and crenulate along the keels. Spruce refers his species to the subgenus *Otigonio-Lejeunea* but states that it approaches certain species of *Eu-Lejeunea* and that it would not be unnatural to include it among them. It agrees with typical species of *Otigoniolejeunea* in its general habit, in its rather large perichaetial bracts, and in the short keels of its perianth; it differs from them, however, because the keels do not project as long horns but merely as rounded processes, and also because the perianth is distinctly beaked. In the writer's opinion these differences are sufficient to remove the species from *Otigoniolejeunea* and to place it in *Lejeunea*. In *L. floridana* the lobules are even smaller than in *L. quinqueumbonata*, the lobes of the leaves are never pointed, and the margins of the leaves and bracts are either entire or much less strongly crenulate.

There are only two other species of *Lejeunea* known from Florida; one of these is the widely distributed *L. americana* (Lindb.) Evans; the other is noted below. *L. floridana* differs from *L. americana* in its laxer habit, in its smaller lobules and underleaves, and in the short and crenulate keels of its perianth.†

In the texture of its leaves *L. floridana* bears some resemblance to poorly developed specimens of *Cheilolejeunea phyllobola* (Nees & Mont.) Schiffn.,‡ with which it also agrees in its small lobules and underleaves and in its autoicous inflorescence. The *Cheilolejeunea* is a more compact species and its prostrate stems are more closely appressed to the substratum; it also exhibits a tendency to develop flagelliform branches with caducous leaves. Its deeply bifid underleaves, however, with sharply pointed divi-

* Hep. Amaz. et And. 230. 1884.

† Mem. Torrey Club 7: 154. *pl. 20, f. 14–26.* 1902.

‡ See Evans, Mem. Torrey Club 7: 143. 1902.

sions offer the best differential characters, and these are supported in fruiting specimens by the broader perianth with plane antical surface and smooth keels.

6. LEJEUNEA GLAUCESCENS Gottsche; G. L. & N. Syn. Hep. 378. 1845.

Lejeunea (*Eu-Lejeunea*) *glaucescens* Steph. Hedwigia **29**: 85. 1890.

Breckell's Hammock (*E. G. Britton 32*). Widely distributed in the American tropics.

The leaves and underleaves of *L. glaucescens* are so much like those of *L. floridana* that it would be difficult to distinguish the species in sterile condition. Even the leaf-cells in the two species are very similar, although the cell-walls in *L. floridana* are perhaps a little more delicate. In both species, moreover, the inflorescence is autoicous and the female flower is subtended by a single innovation. In the involucre and perianth, however, the differential characters become apparent. In *L. glaucescens* the bracts are shorter than the leaves and the lobules are usually distinctly pointed; the bracteole is sharply bifid about one third with acute or subacute divisions; the perianth is five-keeled to below the middle, and the keels, although minutely crenulate, do not project upward as horns; as the sporophyte matures the keels tend to become obliterated. The male spikes of *L. glaucescens* differ from those of *L. floridana* in being shorter and broader.

7. **Cheilolejeunea decidua** (Spruce).

Lejeunea (*Cheilo-Lejeunea*) *decidua* Spruce, Hep. Amaz. et And. 257. 1884.

In hammocks near the homestead trail, between Camp Longview and Cutler (*Small & Carter 1370 p. p., 1408*). Breckell's Hammock (*Howe 81*). Everglades near Camp Longview (*Small & Wilson 1550*). Long Key, mainland (*Small & Wilson 1551*). The original material of *C. decidua* was collected by Spruce in the region of the Amazon, and so far the species has been reported from no other localities. The Florida specimens are either sterile or male, but they agree so perfectly with those distributed in the *Hepaticae Spruceanae* that they can hardly represent any other species.

The specific name *decidua* refers to the fact that the leaves on some of the branches exhibit a strong tendency to break off. They are set free by a tearing across of the lobe near the lobule, sometimes leaving a complete water-sac behind, sometimes tearing away a portion of its wall; in any case the lobule is left intact. In general appearance the species bears much resemblance to two other *Lejeuneae* which have also been found in Florida; namely, *C. phyllobola* and *C. versifolia* (Gottsche) Schiffn.* Both of these species are pale in color and both develop flagelliform branches from which the leaves fall away, leaving nothing except the underleaves behind. *C. decidua* differs from *C. phyllobola* in the long and pointed apical teeth of its lobules, in its dioicous inflorescence, and in its usual lack of a subfloral innovation. It differs from *C. versifolia* in its much larger leaf-cells, none of which develop into ocelli, and in its cell-walls, which show distinct trigones instead of being uniformly thickened.

8. CERATOLEJEUNEA CUBENSIS (Mont.) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 125. 1893.

Lejeunea cubensis Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba **9**: 481. *pl. 18, f. 2.* 1845.

Colura cubensis Trevis. Mem. R. Ist. Lomb. III. **4**: 402. 1877.

Lejeunea (*Cerato-Lejeunea*) *cubensis* Spruce, Hep. Amaz. et And. 202. 1884.

In hammocks near the homestead trail, between Cutler and Camp Longview (*Small & Carter 1355 p. p., 1431; Small & Wilson 1527*), and in the vicinity of Silver Palm School (*Small 2349*). Widely distributed in tropical America.

Although *C. cubensis* has bifid underleaves and consequently belongs to the *Lejeuneae Schizostipae*, it cannot be confused with any of the other members of this group known from the United States. The most striking of the differential characters which it presents are the following: the deep olive-green or olive-brown color due to the pigmentation of the cell-walls, the more or less pointed lobes irregularly toothed in the apical region, the thick-walled leaf-cells with distinct middle lamella, and the four-horned perianth. Most of these characters are of course generic in value.

* See Evans, Mem. Torrey Club **7**: 145. 1902.

The genus *Ceratolejeunea* has many other representatives in the West Indies, and it is possible that one or more of these will be found in Florida. *C. cubensis*, however, may be readily distinguished by the following combination of characters: the lobes are ocellate at the base, the lobules are inflated but small and never develop into large utriculi at the base of a branch, the underleaves are small and orbicular, bifid about one half with acute divisions and never cordate at the base, the inflorescence is autoicous, the bracts and bracteoles are usually coarsely serrate, and the horns of the perianth are short and obliquely spreading to suberect.

9. LOPHOLEJEUNEA SAGRAEANA (Mont.) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1^3: 129. 1893.

Phragmicoma Sagraeana Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba **9**: 464. *pl. 18, f. 1.* 1845.

Lejeunea Sagraeana Mont.; G. L. & N. Syn. Hep. 314. 1845.

Phragmicoma cyclostipa Tayl. *p. p.* Lond. Jour. Bot. **5**: 387. 1846.

Lejeunea cyclostipa Tayl. *p. p.;* G. L. & N. Syn. Hep. 749. 1847.

Symbiezidium cyclostipum Trevis. *p. p.* Mem. R. Ist. Lomb. III. **4**: 493. 1877.

Symbiezidium Sagraeanum Trevis. *l. c.*

Lejeunea (*Lopho-Lejeunea*) *Sagraeana* Spruce, Hep. Amaz. et And. 129. 1884.

In hammocks near the homestead trail, between Cutler and Camp Longview (*Small & Carter 1370 p. p.*). Snapper Hammock (*E. G. Britton 479*). Breckell's Hammock (*E. G. Britton 84; Howe 88*). Miami (*Small & Wilson 1529*). Long Key, mainland (*Small & Wilson 1503 p. p., 1521, 1533 p. p.*). Elliott's Key (*Small 2348 p. p.*). A tropical species, widely distributed in America and in Africa. Stephani * reduces to *L. Sagraeana*, as a synonym, *Lejeunea subfusca* Nees, a species originally collected in Java but now known to have a much wider distribution. *L. subfusca* is based on *Jungermannia subfusca* Nees, Hep. Jav. 36. 1830. It was therefore published before *L. Sagraeana*, and, if the two species are really synonymous, Nees von Esenbeck's specific name should not be superseded. According to Schiffner,† however, it

* Hedwigia **29**: 16. 1890.

† Consp. Hep. Arch. Ind. 295. 1898.

may be possible to keep the two species distinct, and for this reason the well-known specific name of Montagne is here retained.

The genus *Lopholejeunea* is distinguished from the other genera of the *Lejeuneae Holostipae* by the absence of subfloral innovations and by the possession of a four-keeled perianth, the keels being bordered by toothed or laciniate wings. The antical surface of the perianth is smooth, two of the keels are lateral and the others are postical. Most of the species are dark brownish green in color, varying to a paler green on young branches. These peculiarities, although generic in value, will also serve to separate *L. Sagraeana* from the other *Lejeuneae* occurring in Florida.

YALE UNIVERSITY.

Explanation of plate 5

FIGURES 1–8. *Plagiochila Smallii* Evans

FIG. 1. Part of stem, antical view, × 9.
FIG. 2. Part of stem, postical view, × 9.
FIG. 3. Leaf spread out flat, × 16.
FIG. 4. Cells from middle of leaf, × 200.
FIG. 5. Cells from postical margin of leaf, × 200.
FIG. 6. Apex of a large tooth, × 200.
FIG. 7. Perichaetial bract, × 16.
FIG. 8. Perianth, × 24.

The figures were all drawn from the type-specimens.

FIGURES 9–14. *Cololejeunea diaphana* Evans

FIG. 9. Part of plant showing perianth and large ♂ inflorescence, postical view, × 55.
FIG. 10. A branch with ♀ inflorescence, postical view, × 55.
FIG. 11. Part of plant showing small ♂ inflorescenee, postical view, × 55.
FIG. 12. Part of stem showing one leaf with a well-developed lobule, postical view, × 55.
FIG. 13. Cells from apex of lobe, × 265.
FIG. 14. Apex of lobule, × 265.

The figures were all drawn from the type-specimens.

FIGURES 15–21. *Lejeunea floridana* Evans

FIG. 15. Part of stem with perianth, postical view, × 35.
FIG. 16. Branch with two ♀ inflorescences, postical view, × 35.
FIG. 17. ♂ inflorescence, × 35.
FIG. 18. Cells from antical margin of lobe, × 200.
FIG. 19. Apex of lobule, × 200.
FIG. 20. Underleaf, × 200.
FIG. 21. Perichaetial bracts and bracteole, × 35.

Figure 21 was drawn from *1365 p. p.*, the remaining figures from the type-specimens.

New species of western plants

Alice Eastwood

Clematis biflora sp. nov.

Lower leaves pinnately compound, with 5 ternate or quinate leaflets; petioles and rachis tomentose especially at the axils, horizontally spreading; leaflets ovate-acuminate, the terminal about twice as long as the lateral, 4 cm., dentately lobed, the teeth or lobes mucronate, base obtuse, surface somewhat pubescent but not tomentose, veiny, bright-green; leaves of the flowering stems simpler, much smaller, the leaflets cuneate at base: peduncles axillary, 2-flowered (sometimes 1-flowered from the abortion of the other bud); bracts minute, simple or trifoliate: flowers perfect, with sepals elliptical to oblanceolate, rather thin, 15 mm. long, about half as wide, obtuse or mucronate, tomentose: stamens shorter than the sepals, with flat filaments in 2 or 3 sets; anthers narrowly oblong, 1.5 mm. long, as broad as the filaments: carpels bristly-ciliate with discontinuous cilia, hispid at the top and with densely plumose tails an inch or more in length.

This species was collected by Mr. T. S. Brandegee on the Island of Santa Cruz, off the coast of Santa Barbara, California, April, 1888, and listed as *C. pauciflora* Nutt., in the list of the plants of the island published in Zoe (1: 131). From this species it differs in the acuminate, more numerous, and larger leaflets; flowers equal in size to those of *C. lasiantha* Nutt.; sparingly hispid akenes and densely plumose tails. It is also allied to *C. lasiantha*, but differs in the absence of tomentose pubescence, the more numerous leaflets, the thinner and less tomentose sepals and the more glabrous carpels, and most especially in the two-flowered peduncles.

Aquilegia Shockleyi sp. nov.

Stems branching, glabrous on the lower part, viscid-pubescent on the upper, clothed at base with the bleached persistent remains of the leaves, about 4 dm. high: radical leaves varying in length from much shorter than the stem, scarcely reaching the lowest branches, to 5 dm. high with long, stout petioles almost twice as long as the triternate blades; leaflets pale-green, glabrous but under the lens densely covered with shining yellow glands, deeply 3-cleft, cuneate in outline, 3-lobed with cuneate, deeply crenate lobes, the middle leaflet broad, petioluled, the lateral generally unequal-sided, often sessile; cauline leaves with short sheathing petioles, less compound than the radical leaves, upper ones 3-cleft with narrowly linear, acute divisions: bracts simple, linear-acuminate: sepals lanceolate, obtuse, somewhat undulate especially towards the short curved claw; blade 17 mm. long, 6 mm. broad; claw somewhat more than 2 mm. long, rather stout, slightly margined: petals, including the long straight red spur, 3.5 cm. long, attenuate above the globular honey-gland 6 mm., then gradually dilating to the throat; claw yellow, 5–6 mm. long, 4 mm. wide, truncate or rounded at apex, the point of insertion deeply emarginate: stamens with ribbon-like filaments broadening towards the base, anthers oblong-elliptical, acute, 1.5 mm. long; staminodia abruptly acuminate; ovaries almost as long as the styles, together 15 mm., glandular-pubescent with spreading hairs: follicles veiny, pubescent, spreading but little, the seeds extending to the apex: seeds reddish brown, oblong-elliptical.

This was collected by W. H. Shockley at Soda Spring Cañon, Esmeralda County, western Nevada, July, 1888, being *no. 504* of his collection and distributed as *A. truncata* F. & M. It is really nearer *A. formosa* Fisch., but is distinct from that and allied species by the color and pubescence of the foliage, the long, slender spur and prominent lamina of the petal.

✓ **Myosurus nitidus** sp. nov.

Stems 1.5–2 cm. high in fruit: leaves half the height of the plant, glossy, linear: fruiting spike cylindrical, 3–18 mm. high, peduncles 3–10 mm., the longest spike having the shortest peduncle: mature carpels roundish, shining as if polished, flat but with margins thickened, keeled by the appressed or spreading subulate beak.

The specimens collected were in fruit, so the description of petals, sepals and stamens cannot be given. It is near *M. cupulatus* Watson, but differs in the more glossy body of the akene, which is not at all cupulate. Collected by the author at Mancos, Colorado, growing under sage-brush, June, 1891.

Horkelia glandulosa sp. nov.

Stems several from the woody rootstock, 6 dm. high, stout and rather coarse, finely viscid-glandular throughout and softly villous with silky hairs, some of the radical leaves 4 dm. long, with 11 leaflets; petioles stout, furrowed on the inner side, broadly sheathing at base; leaflets oblong to orbicular in outline, cuneate at base, laciniately lobed, the lobes laciniately dentate, the uppermost leaflet largest, some 4 cm. long and wide; petiolules short; cauline leaves smaller, with stipules like the leaflets but somewhat smaller: flowers in terminal cymes, a few smaller clusters also often in the upper axils, the central flower on a pedicel longer than the calyx, the others subsessile: calyx almost concealed by the bractlets, urceolate, rounded at base, the tube 5 mm. long, the divisions 3 mm. wide at base, 5 mm. long, tapering to a slender point, glandular and hairy on the outside, glabrous on the inner; appendages declined, the same shape and length as the calyx-segments but narrower, glandular and hairy on both sides: petals white, oblong, without claws, 6 mm. long, 4 mm. wide: filaments broad, as long as the anthers, inserted in two sets, one below the other on the calyx-tube: styles 5 mm. long, brownish at base, inserted near the tops of the subreniform ovaries: akenes brown, polished, shaped somewhat like an oyster-shell, obliquely concave on one side.

Type collected by the author at Laytonville, Mendocino County, California, August 2, 1903. This is the largest species of the genus so far described; the whole plant has a pleasant fragrance and it seems most closely related to *H. californica* C. & S.

Astragalus Titi sp. nov.

Annual, branching from the base and above, slender, 1–1.5 dm. high, slightly pubescent: leaves 3–6 cm. long, with 5–9 rather distant leaflets, the petioles about half the entire length, slender, stipules falcate-attenuate, membranous with green midvein, those on the lower leaves sparingly clothed with white hairs, those on the upper leaves with black hairs; leaflets narrowly oblong to cuneate, truncate or emarginate at apex, the base narrowing to a short yellow petiolule, upper surface glabrous, lower clothed with scattered hairs appressed diversely, 4–8 mm. long, 2–4 mm. wide: capitate clusters containing about 6 flowers from almost the lowest axils, on slender peduncles 2–3 cm. long, the pedicels 1 mm. long, black-hairy: calyx with similar pubescence, the campanulate tube tinged with purple, 1.5 mm. long, obtuse at base with linear-subulate divisions 2 mm. long: corolla violet, the banner and wings lighter in color than the keel, the banner with orbicular blade 4 mm. in diameter, shallowly emarginate and slightly erose along the apex, the claw 2 mm. long, wedge-shaped, 1.5 mm. wide at top, the base abruptly acute; wings surpassing the keel 2 mm., almost 2 mm. wide at top, the slender claw 2 mm. long with a horizontal, toothlike appendage at top; keel 3 mm. long, rounded at top: alternate filaments shorter, anthers orbicular: style 2 mm. long, thickest at base, tipped by a yellow globular stigma: pods erect, completely 2-celled by the intrusion of the dorsal suture, abruptly pointed and tipped with the curved style, becoming 7 mm. long, appressed white-pubescent, 6-seeded, the cross-section 3 mm. wide, broadly cordate.

Collected by Dr. F. H. Titus, in whose honor it is named, on the Seventeen Mile Drive at Monterey, California, about four miles from Pacific Grove, near an old hut composed of Abalone shells and coal-oil cans. The type specimens were collected by Mrs. Joseph Clemens, May 8, 1904. It is related to *A. Breweri* Gray, differing most noticeably in the fruit. While *A. Breweri* has an ovate pod, attenuate to the long style, this pod is narrowly oblong, as broad near the top as the bottom, and the style is much shorter. Its flowers are smaller and the calyx less densely black-villous.

Vicia Durbrowi sp. nov.

Climbing a meter or more, slender, angled, villous throughout with fine, silky, spreading hairs: leaves almost sessile, with branched tendrils; leaflets 8–11, alternate, thin, conspicuously veiny, equally villous on both surfaces and but little paler on the lower, oblong, 1.5–2.5 cm. long, 1–1.5 cm. wide, sharply dentate from the apex to about the middle, sometimes almost entire, truncate and shortly aristate, obtuse and subsessile at base; stipules sessile, broad, pedately lobed with triangular teeth: racemes shorter than the leaves, on slender curving peduncles which are generally as long as the flowering part: flowers 3–6, pedicels shorter than the calyx: upper lip of calyx purplish with 2 sharply pointed teeth 1 mm. long, separated by a broad rounded sinus; lower with 3 long, acuminate teeth almost 4 times as long as the upper, finely villous, tube rounded at base: corolla violet, the banner with blade slightly broader than claw, 16 mm. long, about half as wide, truncate and shortly mucronate at apex, strongly reflexed; wings with blade slightly longer than claw, broadening towards the rounding top, sharply auriculate at base; keel short, its purple-tipped apex obtuse, 5 mm. long, the claw 7 mm.: style glabrous; stigma tufted at tip with white hairs; ovary pubescent, 7–10-ovuled, on a stipe 4 mm. long: pod villous-pubescent, flat.

Collected by the author at Wawona, Mariposa County, California, along the little stream back of the hotel, July 5, 1902. It is named in honor of my friends Mr. and Mrs. Pierson Durbrow, who were my companions on the trip to the Yosemite when it was collected.

Vicia Copelandi sp. nov.

Climbing rather high and branching, glabrous, angles ribbed leaves almost sessile, with capillary branching and pubescent tendrils; stipules small with several sharply acuminate digitate lobes; leaflets 6–10, petiolulate, elliptical and oblong, to ovate-lanceolate, thin, membranous, glabrous, veiny, paler on the lower surface, obtuse at apex or truncate and mucronate, margin entire or undulate, 1.5–3 cm. long, 1–1.5 cm. wide: flowers few, in racemes shorter than the leaves; peduncles slender, 4 cm. long, pedicels 1–2 mm.: calyx slightly pubescent, its teeth shorter than the tube, membranously white-margined, the 2 upper very short with broad sinus between, the 3 lower subulate, 3 mm. long: corolla almost 2 cm. long, violet; standard orbicular, obcordate, 11 mm. in diameter, the claw broad, almost 1 cm. long, 6 mm. broad, slightly saccate at base; wings surpassing the keel by 6 mm.; keel broad, truncate, with a darker spot at tip: ovary tapering at both ends, at base ending in a stipe as long as the abruptly bent style, puberulent; stigma conspicuously tufted.

This interesting species was collected on the headwaters of the Sacramento River near Sissons at the foot of Mt. Shasta, California, August 12, 1903, by Dr. Edwin Bingham Copeland, in whose honor it is named. Superficially it resembles a species of *Lathyrus*; but is at once distinguished by the stigma.

Lathyrus Goldsteinae sp. nov.

Slender, climbing; stems angled, lower part glabrous, upper clothed with soft spreading pubescence: leaves terminating in long, branching tendrils; leaflets 6–10, opposite or alternate; petioles 1 cm. long on the lower leaves, wanting on the upper; stipules narrowly semi-sagittate, entire, veiny, narrowly attenuate, soft-pubescent, the upper part 1 cm. long, 3 mm. wide, lower 5 mm. long, half as wide; leaflets on short petiolules (about 1 mm.), linear-oblong, tipped with a slender mucro, narrowed at base, 3–4 cm. long, about 5 mm. wide, softly pubescent, paler on the lower than the upper surface: flowers in racemes much shorter than the leaves, 4–6-flowered, the peduncles as long as the racemes; pedicels shorter than the calyx: upper lip of calyx shorter than the lower, 2-cleft with a gusset-like sinus; lower lip with 3 triangular acuminate teeth, 2.5 mm. long; all divisions membranously margined; calyx 6 mm. long, silky-pubescent: corolla violet and white, the banner orbicular, undulate, 1 cm. wide with a broad claw 7 mm.; wings surpassing the keel, oblong; keel strongly geniculate, pointed; ovary glabrous, style sparingly hairy half way from the tip: legume not seen.

Collected at Lakeside Park, near Lake Tahoe, California, July 1, 1903, by Miss Lutie Goldstein, in whose honor it is named. This species, which might easily be mistaken for a *Vicia*, is distinct from related species in its small flowers, racemes much shorter than the leaves, conspicuous tendrils, and narrow entire stipules.

Thermopsis venosa sp. nov.

Stems branching, 4–5 dm. high, glabrous, striate: leaflets obovate-rhomboid to oblong, conspicuously reticulate, glabrous, 5–9 cm. long, 4 cm. wide, cuneate at base; petioles 2–5 cm. long; lowest stipules suborbicular to broadly ovate, 5 cm. long, 3–4 cm. wide; uppermost lanceolate, 2–2.5 cm. long: racemes on long peduncles, 9–12 cm., sometimes with a single bract about the middle; pedicels equaling or surpassing the calyx, erect; bracts lanceolate, equaling or shorter than the pedicels; calyx thin, slightly pubescent, the broad upper part with a shallow triangular notch, lower with 3 triangular teeth: corolla with banner 1.5 cm. long, 12 mm. wide, deeply obcordate, wings shorter, keel truncate at apex, 16 mm. long: legume spreading horizontally, glabrous, flat, generally straight, 5–7 cm. long, 5–7 mm. broad, with a short, stout stipe and acute or pointed apex, the seeds distinctly outlined through the pod.

Collected by the author on the Lewiston Trail near the summit which divides Trinity from Shasta County, California, July 3, 1901. It is distinguished by the large glabrous leaves, broad stipules, flat glabrous legumes and calyx different from any other species. It is most closely allied to *T. gracilis* Howell, but differs in the absence of pubescence and in the shape and size of all the organs.

Rosa rivalis sp. nov.

Shrub, 1 m. or more high, glabrous, with very few spines or prickles, these slender, straight, short from a broad base, 2–3 together, 1–4 mm. long; older wood dark wine-colored; leaflets 5–7, the uppermost largest, oblong to elliptical and suborbicular, or even obovate, 1–5.5 cm. long, 0.5–3.5 cm. wide, the rachis and veins on lower surface tomentose, otherwise glabrous, irregularly serrate; stipules extending half up the petiole, the lower part decurrent, the upper dilated, acuminate, entire or glandular-toothed, the rachis occasionally with a few small prickles: flowers solitary or in 3–4-flowered umbels, terminating clustered peduncles at the ends of the branchlets; bracts foliaceous, obovate, attenuate at apex, tapering to a broad petiole 1–2 cm. long; pedicels slender, glaucous, 1–2 cm. long: sepals ovate, tapering to a long slender, foliaceous tip, lanceolate, 5 mm. to more than 1 cm. long, the slender petiole-like part 5 mm., the lower part keeled, with a few gland-tipped hairs, and tomentose margins, the entire calyx 2 cm. long; corolla rose-colored: immature fruit globular, with a short neck, glaucous.

Collected by the author along a small stream, in the shade of the trees, near Laytonville, Mendocino County, California, August 3, 1902.

This seems unlike any other species in California. It is distinguished by the stems almost destitute of prickles, the extremely long foliaceous calyx-divisions, and the peculiar inflorescence.

Adenostoma fasciculatum densifolium var. nov.

This is marked from the typical form by the closely clustered fascicles of leaves on the flowering stems; the leaves are short-aristate, with few scattered hairs; the inflorescence is narrow, a densely-flowered spicate thyrsus, often with one or two short branches at base. The inflorescence resembles a slender finger in shape and size. This singular variety was collected on Mt. Wilson, near Pasadena, California, by Fordyce Grinnell, Jr., June 6, 1903.

Heuchera Merriami sp. nov.

Rootstock thick, coated with dry, sheathing petioles, horizontal; stems several from the caudex, 2 dm. high, generally with a small leaf near the base: radical leaves orbicular, truncate at base, slightly lobed, the lobes crenate and each crenature apiculate, ciliate, 2–3 cm. wide, and about as long, glandular and hispid especially on the lower surface; petioles 1–4 cm. long, clothed with glandular, spreading hairs, stipules white-membranous, very glandular, auriculate at apex, the entire base of the petiole 5 mm.: panicle glandular-puberulent and hairy, somewhat contracted: peduncles 5–10 mm. long, cymes closely 5–9-flowered; the pedicels of all except the earliest shorter than the calyx; bracts 3-parted with linear-attenuate divisions, the upper simple; bractlets minute, linear-attenuate: calyx orbicular-campanulate, 3 mm. long in flower, 5 mm. in fruit, the divisions 1 mm. long, varying in width in the same flower from 1–2 mm.; tube rounded or slightly cuneate at base: petals white, oblanceolate, obtuse, narrowed to a bulb-tipped base: filaments rather broad, inserted lower on the calyx-tube than the petals and surpassing them; anthers yellow, orbicular: style and ovary puberulent, stigmas capitate and later becoming bulbous, exserted and strongly divaricate: seeds brown, oblong or elliptical, echinate, 0.5 mm. long.

Collected at the upper part of Canyon Creek, Trinity County, California, in fruit, August, 1899, by Dr. C. Hart Merriam, in whose honor it is a privilege to name it. The author collected it in flower and fruit at the same general locality, July 14, 1901, the latter specimens being taken for the type.

Lithophragma trifoliata sp. nov.

Stems from slender, running rootstocks, striate, scabrous-hispid, upper part clothed with gland-tipped hairs, generally 2-leaved and about 3 dm. high: radical leaves with long, lax, glandular-hispid petioles, dilated and sheathing at base, erosely ciliate; blade orbicular in outline, the 3 palmate divisions tapering to a slender base, each with 3 or 4 cuneate lobes with margin crenate the crenatures callous-apiculate, scabrous on both sides, lower leaves often simpler; cauline leaves on short petioles with broad, membranous, erosely ciliate stipules, the blades with sharper and narrower divisions than the radical leaves: flowers few, in short subcapitate racemes; bracts white-membranous, enclosing the base of the petioles, about 1 mm. long, twice as broad, sparingly ciliate, pedicels erect, shorter than the calyx, about 3 mm. long; calyx turbinate, attenuate at base, broadest at the insertion of the petals and stamens, the divisions conniving and narrowing the calyx at the top, triangular, apiculate, as long as the part of the tube above the ovary: petals 3-lobed to below the middle; blade 7 mm. long: the lateral divisions linear, acute, the terminal obovate, obtuse, claw slender, 3 mm. long: ovary half-included, the stigmas broad, sessile.

Collected by Mrs. R. M. Austin in Modoc County, also by her daughter, Mrs. C. C. Bruce, in the foothills near Chico, Butte County, California, April, 1897, *no. 1844* of her collection (type).

It is peculiar in the narrow turbinate calyx with connivent lobes and the subcapitate raceme. It is nearest to *L. affinis* Gray, but has a much longer calyx, the tube more narrowed at base.

Jepsonia heterandra sp. nov.

Roots fleshy: stems slender, several from the thick fleshy caudex, flowering in the autumn, loosely racemose, or paniculate, glandular-puberulent: leaves appearing in spring, orbicular-reniform with many short, crenate lobes, the crenatures callous-apiculate; blade subglabrous; petioles glandular-hairy, 3–6 cm. long, rather broad, sheathing the branches of the caudex: pedicels filiform, 5–15 mm. long: calyx-tube with 10 red veins, truncate, cuneate at base, 4–5 mm. long, the triangular-acute lobes half as long: petals white, tinged or veined with rose, acute at apex, narrowed to a short claw at base: stamens of two forms in the same plant, some flowers with filaments only as long as the anthers, others with filaments 2.5 mm. long, anthers orbicular, rose-colored: styles in the short-stamened flowers about 5 mm. long, in the long-stamened less than 1 mm.; stigma bulbous: seeds immature.

Collected by Mr. J. W. Congdon on banks of Merced River, near Benton's Mills, Mariposa County, California, in October, 1883, with leaves April, 1884. The description of the root is taken from specimens collected by Major R. A. Scupham, October 24, 1889, six miles east of La Grange at the extreme west part of Tuolumne County, growing on a slate outcrop.

The species differs from *J. Parryi* Small in broader and more acute petals, longer calyx-teeth, and heterogonous flowers.

Arctostaphylos franciscana sp. nov.

Low spreading shrub, rooting along the stems: older stems dark red, the exfoliated bark persisting, younger stems somewhat white-tomentose: leaves narrowly obovate to oblanceolate, glossy-green and glabrous on both sides when old, slightly tomentose when young, the apex sharply acuminate and aristate, base pointed, scabrous-ciliolate along the margins, 2–3 cm. long, 5–12 mm. wide; petioles 2–4 mm. long: panicles short, terminating some of the branchlets; peduncles 5 mm. long, tomentose; bracts 2–5 mm. long, shorter than the glabrous, ribbed pedicels, the lower longest, ovate, attenuate; pedicels becoming deflexed and longer in fruit, 6 mm.: calyx-divisions orbicular, thin, membranous, glabrous, generally without cilia, 1 mm. in diameter: corolla broadly urceolate, 6 mm. long, 5 mm. broad, sparingly hairy in the throat and below, the short rounded divisions spreading, minutely papillate: stamens shorter than the style; filaments subulate-attenuate, 2 mm. long, with cilia sparingly margining the base; anthers dark wine-colored, 1 mm. long, the hairy horns slightly longer, deflexed: style somewhat club-shaped, scabrous-puberulent on the ribs and depressions, stigma 0.5 mm. broad, not exserted; ovary conical, as broad at base as the receptacle, a little more than 1 mm., scabrous-puberulent: berry glabrous, globular, 5–7 mm. in diameter. The bud-scales are red or yellowish.

This grows in Laurel Hill Cemetery in San Francisco, over a limited area on rocky ground. There are some plants on the road to Pt. Reyes lighthouse which appear to be the same, but which have not flowered for three years and have never been collected in either flower or fruit. This has been confounded with *A. pumila* Nutt. It differs in more prostrate habit, glabrous foliage, larger flowers and fruits. *A. pumila* appears to be local near Monterey.

Arctostaphylos auriculata sp. nov.

Shrub with erect branches, 1–1.5 m. high, old wood smooth, red-brown; young stems glaucous, clothed with fine, white, arachnoid tomentum and long, loosely spreading, fine, white hairs: leaves oblong to ovate, mucronate at the obtuse or acute apex, auriculate at base, the rounded auricles generally longer than the petiole, with entire or slightly undulate margin, pubescence similar to that at the stem, and evident veins, 3–5 cm. long, 2 cm. wide, thickly clustered on the branchlets, overlapping, almost concealing the inflorescence: flowers in close, somewhat pendent panicles terminating the branchlets; bracts linear, sessile, acute or obtuse, lowest about 1 cm. long, 3–4 mm. wide, spreading; bractlets at base of pedicels 2, white-membranous, orbicular, 2 mm. long; pedicels rose-colored, 3–5 mm. long, clothed with short, spreading white hairs: calyx with orbicular rose-colored divisions, glabrous, ciliate, 2 mm. long, incurved in anthesis, later revolute: corolla rose-colored, urceolate, 6 mm. long, 5 mm. in diameter at base, the divisions broadly orbicular, obtuse, obcordate, or erosely denticulate: filaments ciliate at the thickened base, pale rose-colored, the dark wine-colored anthers sub-orbicular, a little more than 1 mm. long, the curving horns 1.5 mm. long: ovary clothed with long, spreading white hairs: receptacle dark wine-colored: style terete, stigma greenish: honey abundant, giving a sweet fragrance to the flowers.

Collected by the author on Mt. Diablo, California, on the trail above the Boyd Ranch, February 22, 1903, in flower; in immature fruit May 30, the same year.

This belongs to the same group as *A. canescens* Eastwood. The rosy flowers, the glaucous foliage, and the branching roots are features in which the species are alike, but *A. auriculata* has leaves of a very different shape, branches more erect, and an appearance so different that they could never be confused by even the most superficial observer. In the shape and arrangement of the leaves and hairiness of stem the species resembles *A. Andersoni* Gray.

Cynoglossum Austinae sp. nov.

Stems about 5 dm. high, glabrous throughout, scaly at base: lower leaves suborbicular, 8 cm. in diameter; the other leaves oblong, acuminate, 8–12 cm. long, 4.5 cm. wide, undulate, decurrent on the broad petiole which varies in length from 13 cm. on the lowest leaves to 5 mm. on the topmost; upper leaves much smaller, ovate, upper surface glaucous, lower canescent with irregularly appressed pubescence: panicle somewhat contracted in flower, widely expanding in fruit; peduncles and pedicels glabrous, the latter filiform, lengthening in fruit: calyx deeply divided, the divisions linear-oblong, unequal, about 7 mm. long, 2 mm. wide, obtuse or acute, canescent: corolla purplish, the tube generally longer than the calyx, 7 mm., divisions oblong-orbicular, 4 mm. wide, slightly undulate; crests short, ligulate, conspicuous, truncate, 2 mm. broad and long: anthers almost sessile, nearly 2 mm. long, the tips exserted: only one or two nutlets maturing, these obovate or oblong, 1 cm. long, the lower part smooth or slightly wrinkled, the upper muricate with spines confluent, subulate, a few only tipped with stellate hooks.

Collected by Mrs. C. C. Bruce, the daughter of Mrs. R. M. Austin, in whose honor it is named, at Butte Creek, Calfornia, March and June, 1897, being *2092* of her collection.

It differs from the other California species in the peculiar nutlets. These are not at all flattened or depressed. The crests in the throat, too, are more conspicuous.

Cryptanthe trifurca sp. nov.

Stems diffusely branched from the base and above (occasionally simple in depauperate specimens), 1–1.5 dm. high, cinereous with stiff, white, horizontally spreading hairs 2 mm. long, also with appressed pubescence beneath: leaves linear, callous-tipped, strongly ribbed, becoming keeled, with thickened margins, 1–3 cm. long, 1–3 mm. wide, the pubescence like that of the stems but with pustulate bases to the bristle-like hairs: inflorescence generally 3-forked, the spikes bractless with the flowers secund, subsessile, close but not crowded except when in bud, one flower in the forks: divisions of the calyx linear-lanceolate, obtuse, 3 mm. long, with pubescence like the leaves, connivent in fruit but with tips free, midrib keeled and very bristly: corolla white, salver-form, the limb 5.5 mm. in diameter, with orbicular divisions 2 mm. broad, the tube shorter; crests in the throat white, minutely papillate, slightly emarginate, each one distinct and with a smaller, rounder crest below on a level with the tops of the anthers: stamens inserted along the middle of the tube; filaments very short; anthers with cells united only near the middle: lower part of calyx-tube somewhat pubescent: nutlets 2–3 maturing, ovate, obtusely pointed, truncate at base, a little more than 2 mm. long, 1 mm. wide, mottled in two shades of brown, obscurely and sparsely papillate, very glossy; dorsal surface flattened, the groove on the ventral surface forked at base but closed throughout, ⅔ attached to the subulate gynobase.

Collected by Dr. Edwin Bingham Copeland at Klamathon, Siskiyou County, California, July 5, 1903 (*no. 3550* of Baker's distribution).

This species is nearest to *Cryptanthe ambigua* (Gray) Greene, but differs in habit of growth, being more erect and rigid, in the inflorescence, in the color and surface of the nutlets and the closed scar; the flowers are similar but the crests in the throat are not identical. The original figure of *C. ambigua*, which was described as *Eritrichium muriculatum* Torr. (Bot. Wilkes Exped. *pl. 13*), has no crests in the throat of the corolla-tube; the calyx-segments are more connivent, the nutlets are dull instead of glossy and the muriculations are more evident.

Phacelia eximia sp. nov.

Annual, about 3 dm. high, branching widely, with weak stems, clothed with fine white spreading bristles and glandular tomentum beneath: leaves compound, with generally one large leaflet at the end and 2 or 3 smaller ones below; terminal leaflet petiolulate, obovate in outline, deeply 3-lobed or undivided, laciniately crenate, hispid and glandular: peduncles flat, about the entire length of the leaf: racemes axillary from even the lowest leaves, spreading, 10–15 cm. long, the peduncle about ⅓ the entire length; bracts none, pedicels 1–2 mm. long: calyx with narrow, oblanceolate divisions, attenuate at base, loosely spreading, in flower 5 mm., in fruit

10 mm. long, 1 mm. broad near the top, filiform at the base, conspicuously hispid with fine bristles 3–5 mm. long: corolla purplish, veiny, funnel-form, 8 mm. long, the border almost 1 cm. across; lobes 2.5 mm. wide, not so long, broad and rounded; appendages 1.5 mm. above the base of corolla, attached their whole length, 1 mm., rounded at top, lunate at base: filaments attached at base to the appendages, filiform, together with the small brownish anthers and divisions of the style conspicuously exserted 5–6 mm.: style 1 cm. long, the branches 8 mm.; ovary globular, hispid like the calyx and glandular; ovules 4: capsule with two seeds, these brown, ovate, rounded on the dorsal side, keeled on the ventral, 2 mm. long, marked with shallow pits.

Type collected on Mount Wilson along the trail, Los Angeles County, California, by Fordyce Grinnell, Jr., December 31, 1903.

It is related most closely to *P. hispida* Gray, but is distinguished by the racemose instead of paniculate inflorescence, larger and more loosely scattered flowers, less dissected leaves, entirely different habit of growth, and the conspicuously exserted stamens and style. It is a lovely species, perhaps the most beautiful of the group to which it belongs.

Polemonium shastense sp. nov.

Stems cespitose from a multicipital caudex which is densely clothed with dead petioles, 7 cm. high: stems and leaves pale-green, glandular-pubescent: radical leaves 3–4 cm. long, the petiole gradually dilating downwards, 2 mm. wide at base, rose-colored; leaflets generally opposite, 15–21, ovate-orbicular but unequal-sided, punctate, about 2 mm. in diameter, slightly cuneate at base and narrowing abruptly to a short petiolule as broad as long; rachis channelled, 0.5 mm. wide; cauline leaves few, as many as the branchlets, similar to the radical leaves, but with shorter petioles: inflorescence cymose; peduncles slender, the lower much longer than the upper; pedicels 1–3 mm. long: calyx as long as the corolla-tube, 5 mm., campanulate, with oblong obtuse divisions 2 mm. long, a little more than 1 mm. wide: corolla funnel-shaped, white, veined and often tinged with pink, the throat yellow, the tube proper 2 mm. long, the throat 3 mm. long, hairy within, the oblong divisions 6 mm. long, 4 mm. wide: stamens and style exserted from the throat but not from the bud; filaments 4 mm. long, filiform, hairy at the insertion; anthers elliptical, obtuse, surpassing the stigmas: stigmas 2–3, a little more than 1 mm. long: capsule ellipsoidal, as long as the calyx-tube.

This was collected on Mount Shasta, California, altitude 3120 meters, July 16, 1903, by Dr. Edwin Bingham Copeland, and distributed by C. F. Baker, being his number *3515*, of 1903.

It comes under the aggregate *P. viscosum* Nutt., to which it seems closely allied, but as that has been an aggregate of many different forms it seems unlikely that this from Mt. Shasta can be the same as plants collected on the "Headwaters of the Platte."

Pentstemon Austini sp. nov.

Glabrous and pale-glaucous, stout from a woody stock, 5 cm. thick, branching from the base, almost a meter high: lower leaves oblong or ovate, on broad petioles as long as the blades, acute, sharply denticulate; upper leaves with shorter, broader petioles, the uppermost meeting but not perfoliate: thyrsus virgate, 3–4 dm. long, the cymes 2–4-flowered, distinct: peduncles and pedicels slightly and finely glandular-pubescent, the peduncles shorter than the unequal pedicels: sepals ovate-lanceolate, pink on the margins, 5 mm. long, slightly glandular, closely, longitudinally veined: corolla rose-colored with the tube slightly longer than the calyx, the throat abruptly dilated, 2.5 cm. long, slightly glandular; upper lip of 2 rounded lobes of half its length, lower with 3 spreading lobes, glandular within but not bearded: stamens glabrous, anther-cells confluent and explanate; sterile filament as long as the fertile, scarcely broadening at tip, glabrous: earliest capsules twice as long as the later ones, surpassing the calyx: seeds irregularly angled, black, glossy, minutely papillate.

Collected at Oak Creek, Inyo County, California, July 4, 1899, by Mr. S. W. Austin, in whose honor it is named. Number *1783* of the Death Valley Expedition, collected in the mountains of Inyo County, is the same. It differs from *P. spectabilis* Thurber, to which it is closely allied, by the simpler virgate inflorescence, the shorter tube of the corolla, the less dilated sterile filament, the anthers glabrous along the line of dehiscence instead of ciliate, and the smaller corolla. *P. floridus* Brandegee is probably nearer, but it differs also from this in the distinctly petioled radical leaves, the glaucous foliage, the longer tube of the corolla and different shape of the lobes, the divaricately spreading divisions of the anthers in bud instead of parallel; the corolla is also less ventricose below the opening.

Pentstemon macranthus sp. nov.

Perennial from a woody tap-root; stems about 8 dm. high, lower part glabrous and glaucous, upper glandular: lower leaves obovate-spatulate, tapering to broad connate-clasping petioles; upper cauline perfoliate, oblong to ovate, 1–1.5 dm. long, 4–6 cm. wide, irregularly and sharply denticulate, glaucous and glabrous: panicle narrow, interrupted, the short peduncles 2–3-flowered, 1 or 2 pedicels more than twice as long as the remaining one, from 3–15 mm.: sepals ovate, acute, 5 mm. long, membranously margined, glandular, wrinkled, overlapping: corolla rose-colored, 4 cm. long, the tube slightly curved, 1 cm. long, 5 mm. broad at base, the throat 15 mm. broad; upper lip 15 mm. long, with lobes 7 mm. wide, 5 mm. deep; lower lip with 3 rounded, spreading bearded lobes: sterile filament conspicuously exserted, hooked at the apex and densely bearded with long, yellow hairs; fertile stamens included, anthers and filaments glabrous: ovary shorter than the calyx.

Collected in IXL Cañon, Churchill County, Nevada, June 15, 1902, by Otto F. Heizer. It is closely related to *P. Palmeri* Gray, differing in the more contracted infloresence, smaller calyx, larger corolla, with tube more than twice as long as the calyx, the anthers without the ciliate edges on the expanded cells.

Pentstemon Grinnellii sp. nov.

Suffrutescent, stout, erect, green and glabrous throughout except the somewhat viscid-glandular inflorescence: lower leaves on broad petioles half as long as the blades, middle and upper subsessile, uppermost connate-clasping; lower leaves smaller than the upper stem-leaves, ovate-oblong or orbicular, sharply dentate, 1.5–4 cm. long, 1–2 cm. wide; upper ovate-acuminate, cuneate or cordate at base, about 8 cm. long, 2–3 cm. wide: panicle pyramidal, loose and open; peduncles 2–3-flowered the lateral pedicels half as long as the middle, twice as long as the calyx: sepals ovate-acuminate, 5 mm. long, with narrow, membranous margins, veins evident, closely longitudinally parallel: corolla cream-colored diffused with pink, the proper tube shorter than the calyx, abruptly dilated, becoming 2 cm. in diameter across the top; border spreading, 2-lipped; upper lip 1 cm. long, with 2 lobes 5 mm. broad and half as long; lower lip with 3 orbicular reflexed lobes separated from each other by an obtuse sinus, bearded in the throat: anther-cells confluent and explanate after dehiscence; sterile filament glandular-hirsute at base and up to the white bearded exserted tip.

Collected on Mt. Wilson, near Pasadena, California, June 6, 1903, by Fordyce Grinnell, Jr., in whose honor it is named as a mark of appreciation for a collectian of plants made on the mountain and given to the California Academy of Sciences. It is near *P. Palmeri* Gray, of which it may prove to be a variety. It is distinguished from that species by bright-green instead of glaucous foliage, and a shorter tube to the corolla, which is broader and shorter, and with two lips widely spreading.

Pentstemon anguineus sp. nov.

Stems branching at base, glabrous to the inflorescence: lowest cauline and radical leaves orbicular, ovate, or oval, tapering to petioles about as long as the blades, together 2–9 cm.; upper cauline leaves ovate-oblong, cordate or auriculate at the connate-clasping base, all serrate generally with the edges of the teeth revolute, the uppermost pair almost entire, upper surface bright-green, lower paler: inflorescence short, open-paniculate, densely glandular-villous, the hairs tipped with linear glands; bracts and bractlets ovate-lanceolate, glandular-villous; peduncles spreading, 5–10 mm. long, pedicels shorter; calyx campanulate, obtuse at base, 4 mm. long, the divisions acute or obtuse but not attenuate: corolla reddish-violet, 17 mm. long, the two lips separated by a broad sinus; the divisions of the upper lip oblong, rounded, half its length; lower lip longer than the upper, of 3 similar, slightly bearded divisions; tube about as long as the calyx, abruptly dilated to the throat, the entire corolla about 15 mm. long, half as wide: stamens included within the upper lip; sterile filament conspicuously exserted from the yawning mouth, conspicuously bearded at apex, less so below; anthers minutely scabrous externally, canescent within: ovary tapering to the filiform style, stigma capitate.

Collected near Shelley Creek on the Waldo-Crescent City road, northwestern California, growing in rather wet places at the base of cliffs and rocks, in bloom June, 1903. It is probably nearest *P. Rattani minor* Gray, but the flowers are larger, the leaves serrate and the sterile filament more conspicuously exserted. The corolla looks like the head of an aggressive snake, with open mouth and hairy tongue protruded.

Pentstemon scabridus sp. nov.

Shrubby at base, forming clumps, with numerous, slender, erect, virgate branches, 4–5 dm. high, scabrous-hispid throughout and glandular especially above, old bark shreddy: leaves opposite, at base becoming alternate, ovate, dentate, acute, 1 cm. or less in length, 3–5 mm. wide, appressed somewhat to the stem: flowers solitary in the upper leaf-axils on very short peduncles, bracted at base, the 2 lanceolate bracts about as long as the sepals: sepals lanceolate, 4 mm. long: corolla ochroleucous tinged with pink, glandular, the tube twice as long as the calyx, dilated but little at the throat; upper lip erect, obcordate, lower with 3 oblong, reflexed, undulate lobes: stamens and style equaling the upper lip, glabrous; sterile filament filiform, much shorter, glabrous; anthers with cells confluent but not explanate: capsule lanceolate-acuminate in outline, shorter than the sepals.

Collected by the author on dry hills near Kern Lakes and on the Hindman's Trail over Coyote Pass, Tulare County, California, July 19, 1903. This species is peculiar in *Pentstemon* in having single-flowered peduncles so short that the flowers appear sessile. It really looks unlike a *Pentstemon*, and at first I was inclined to set it by itself.

✓ **Pentstemon Berryi** sp. nov.

Stems woody, branching from woody rootstock, 1–2 dm. high, lower part puberulent, upper glandular-hairy: leaves rather thin, lower elliptical-oval and oblong, tapering to a short petiole, 1–3 cm. long, 8–12 mm. wide, serrate above the base, mucronate; upper cauline leaves sessile, acuminate, with fewer marginal teeth: peduncles 1-flowered, erect, 5 mm. long: sepals lanceolate-attenuate, 12 mm. long, sparingly ciliate and glandular-hairy: corolla red, 3 cm. long, glabrous externally, lower lip bearded with long white hairs extending from the base of the 3 rounded divisions half down the tube; upper lip glabrous within, erect, the two deltoid obtuse divisions less than half its length, with undulate margins: stamens included; filaments glabrous; anthers long-woolly; sterile filament yellow-bearded for more than half its length, thickest at apex: capsule only 1 cm. long.

Collected by the author at the head of Cañon Creek, Trinity County, California, July 12, 1901. It is named in honor of my friend, Mr. S. Lucien Berry, without whom the trip to this inaccessible region would have been unsuccessful. It is a beautiful species allied to *P. Menziesii* Hook., from which it differs in the greater size of the flowers, the red instead of violet corolla, the taller stems, and the more serrate and thinner leaves. The flowers are more like *P. Davidsonii* Greene, but the appearance of the plant is entirely different and the flowers have the color of those of *P. Newberryi* Gray. There is a specimen collected by Harley P. Chandler near Marble Mountain, Siskiyou County, California, *no. 1599*, which appears to be the same. It was distributed as *P. Menziesii Newberryi*. It resembles this only in the color of the flowers.

Orthocarpus maculatus sp. nov.

Stems slender, with few slender branches, appressed-villous and minutely scabrous: leaves ovate, entire, obtuse, sessile, 1–1.5 cm. long, 3–5 mm. wide: flowers in slender spikes becoming 1.5 dm. long, lower ones more scattered, bracts shorter than the flowers, oblong, 1 cm. long, irregularly 3-toothed or lobed, thin; upper ones yellowish-white at tip: calyx with attenuate almost equal divisions longer than the tube, together 10–12 mm., glandular-hairy: corolla cream-colored, with a few black-purple spots on the lower part of the sacs, glandular; upper lip straighter, obtuse, the broad stigma barely exserted; lower lip with sacs longer than wide, the 3 teeth half as long as the galea: capsule narrowly oblong, light brown: seeds dark with a loose, membranous, reticulated, thin coat.

Collected by the author at Fort Bragg, Mendocino County, California, Aug. 9, 1902. It is to be placed near *O. lithospermoides* Benth., and belongs among the closely related species which differ generally chiefly in the shape of the corolla.

Orthocarpus Brownii sp. nov.

Annual, simple or branched, 1–2 dm. high, purplish below, becoming white above, clothed with soft, spreading, white, jointed hairs: leaves with 3–5 narrowly linear, ribbed divisions, narrower than the rachis, attenuate, erect, spreading: bracts flabelliform, with ovate rachis and 10 divisions, the whole 1–2 cm. wide, 5–10 mm. long, densely villous with long hairs and with a short glandular integument beneath: flowers in dense spikes, the earliest somewhat scattered, the lateral spikes shorter than the main one, this in branching plants becoming 1 dm. high but in simple-stemmed plants shorter: calyx thin, becoming inflated, white tinged with green, villous and glandular-hairy; the 4 linear, triangular-attenuate divisions almost equal, 3.5 mm. long; tube globose-ovoid, in fruit surpassed by the capsule: corolla yellow, glandular and villous, the tube surpassing the calyx, 8 mm. long, broadening at base and throat, narrowed near the middle; upper lip straight, acuminate, surpassing the lower, 5 mm. long from the throat; lower lip much inflated, the 3 sacs as broad as long, 4 mm.: stigma included at first, later exserted, unequally 2-lobed: ovary glabrous, ovate in outline: seeds numerous, irregularly obovate, with white, cellular coats.

Collected by H. E. Brown at Pitt River, Shasta County, California, *no. 220.* The best specimens are those of Brown and Heller, *no. 5459* (type), collected in Berry Cañon near Clear Creek, Butte County, California. There are specimens in the herbarium of the California Academy of Sciences from Mrs. C. C. Bruce, collected at Little Chico, *no. 2088;* also from Big Meadows, collected by Mrs. Austin in 1882.

Orthocarpus noctuinus sp. nov.

Annual, about 2 dm. high, slender and with slender, upwardly spreading, somewhat cymose branches, cinereous-puberulent: leaves narrow, attenuate to a filiform apex, simple or with two filiform divisions, longest leaves about 6 cm.: inflorescence of main stem an oblong spike with lowest flowers scattered, that of the branches becoming subcapitate; pedicels scarcely evident; bracts crimson-tipped, with 3–5 filiform divisions shorter than or equaling the calyx, the broad lower part 3-nerved: calyx with four narrowly linear divisions, deeply cleft on the dorsal side, front about half as long as the slender purplish tube: corolla with long tube, 12 mm. below the swell of the throat, woolly, tinged with rose-color, throat white; galea broadly subulate, straight, rose-colored, pubescent; lower lip ventricose, trisaccate, each sac with 2 folds, yellow banded with crimson, and with crimson dots in the intervals between the folds, the 3 involute lobes colored like the galea and surpassing it, the middle lobe longest, narrowly deltoid, mucronate: filaments and style glabrous: stigma globose-capitate, purplish-black: ovary linear-oblong.

Collected by the author at Inverness, Marin County, California, on the hills back of the settlement, May 6, 1901. It is near *O. densiflorus* Benth., but differs in its more loosely branched habit, more slender stems, and longer flowers, and in the great length of the lower lip. In *O. densiflorus* the lower lip is shorter than the galea and the spike is more densely flowered. It is named because of the appearance of an owl produced by the markings on the corolla. This also occurs in *O. densiflorus*, and is the reason of the name owl's clover which has been applied to the latter species.

Orthocarpus falcatus sp. nov.

Slender, simple, erect, 1–2 dm. high, villous throughout: lower leaves narrowly linear, 2–3 cm. long, 1 mm. wide; upper stem-leaves with 3 divisions similar to the lower leaves and extending to within 5 mm. of the sessile base: lower flowers scattered, pedicellate in the axils of the upper leaves or leaf-like bracts; pedicels erect, 1–5 mm. long; upper flowers subsessile, forming a subcapitate cluster; bracts similar to the upper leaves but shorter and broader, surpassing the flowers: calyx with linear-attenuate divisions, 5 mm. long, as long as the tube; this becoming inflated and papery, equaling the ovary: corolla hispid with short pubescence, the slender tube barely surpassing the calyx; upper lip falcate, 2 mm. longer than the lower; lower lip with 3 sacs longer than broad, hairy within, the 3 teeth very small: stigma not exserted: pod light-brown, elliptical: seeds many, brown, with loose, membranous, reticulated coat.

Collected on Smith or Palomar Mountain, at an elevation of 1500–1800 meters, San Diego County, California, June 1–4, 1891, by S. B. Parish. It was distributed as *O. hispidus* Benth., to which it is allied, but has flowers more slender and with falcate or curved galea.

Castilleia Clementis sp. nov.

Stems many from a woody root, virgately branched, about 2 dm. high, densely white-tomentose throughout: leaves crowded and fascicled generally up to the dense spike, thick, linear, simple or some with a pair of linear lobes perpendicular to the rachis, obtuse, subterete when young, 1–3 cm. long, 1–2 mm. wide: spike ochroleucous, 5–10 cm. long; lowest bracts similar to the leaves in color, texture and pubescence, pedately 3-parted, the two lateral divisions 8 mm. long, the middle often 3-cleft at apex; upper bracts with broader rachis and divisions more spatulate and broader, less tomentose and tipped with yellowish-white: calyx 9 mm. long, cleft equally a little above the middle into 2 entire divisions 4 mm. wide, truncate along the apex but with rounded angles, 2-veined, tomentose externally, puberulent within, ochroleucous: corolla with the tip of the broad galea exserted 1–2 mm.; tube greenish, 4 mm. long, a little more than 2 mm. in diameter; lower lip short, not protuberant, dark-green, the two outer teeth larger than the middle and much less incurved; upper lip 5.5 mm. long, 3 mm. wide at the throat, almost 2 mm. at the rounded top, lower part with thickened margin, sides 1-nerved, keel thickened, glandular-puberulent: style rather thick, the capitate stigma exserted: stamens with short glabrous filaments and slender anthers:

capsule ovate-oblong, unequal-sided, the coat thick and tough, brown, glabrous, tipped with the base of the style: seeds somewhat cuneate in shape, with a white membranous favose-reticulate coat.

Type collected at Carmel by the Sea, Monterey County, California, June 16, 1904, by Gwendolan Newell. The species was discovered a short time before by Mrs. Joseph Clemens, whose enthusiastic love of the wild flowers this peculiar species will commemorate. It is related to *C. foliolosa* H. & A., but has an entirely different corolla.

Antirrhinum ovatum sp. nov.

Annual, simple or branching diffusely from the base, 1–3 dm. high, glandular-hairy throughout with spreading hairs, flowering from almost the lowest axils: leaves ovate, sessile or the lowest short-petioled, truncate, retuse or obtuse at the apex, which has a spot destitute of the dense glandular hairs that clothe the rest of the surface, 1–2 cm. long, 0.5–1 cm. wide: flowers axillary on short peduncles not so long as the calyx: divisions of the calyx unequal, four linear, acute, 5 mm. long, 1 mm. wide, the fifth foliaceous, elliptical, 10–12 cm. long, 5 mm. wide: corolla rather large, with widely open throat, the upper lip pink, lower white; tube curved, prominently saccate at base, widening abruptly to the throat, about 7 mm. long, 4 mm. broad, throat ample; upper lip 8 mm. wide, of two rounded lobes; lower lip reflexed, with smooth palate and 3 short, rounded, reflexed lobes: stamens hairy at the insertion at the base of the tube, otherwise glabrous, the two shorter ones free, the other two united by the thick anthers; ovary and lower part of style glandular-hairy, the upper part smooth, broader: fruit tipped with the persistent style: seeds cuneate, rugose and the rugae muricate.

Collected by the author on the Carisa Plains, San Luis Obispo County, California, and the hills adjacent to the Painted Rocks, June 12, 1902.

It grew in the somewhat alkali soil, and has the slight odor of carrion so often found among such plants. While it is larger-flowered than any other California species, it is an unattractive-looking plant. It has the short branchlets that look as if they might be tortile and prehensile if there was anything to cling to, but none of the specimens observed possessed the habit or perhaps the chance.

Antirrhinum emarginatum sp. nov.

Annual, erect, diffusely branching from or near the base, 2 dm. high, leafy, viscid-pubescent throughout with spreading hairs: leaves alternate or the lowest occasionally opposite, obovate, oblong, or oblanceolate, the upper ones induplicate, entire, tapering at base to a short petiole, the apex obtuse but with a conspicuous notch subtended by a peculiar gland forming a gusset; lowest leaves 6 cm. long, 2 cm. wide, the upper 2 cm. long and 6 mm. wide: flowers solitary, axillary on short peduncles: sepals distinct, unequal, similar to the upper leaves but smaller, about 7 mm. long, 12 mm. wide, the notch filled by a gland similar to that on the leaves: corolla almost 1 cm. long, pale-lilac to white with sulphur-yellow saccate palate; spur rounded, saccate; tube widening upwards, 5 mm. long; upper lip 2-parted, or obcordate, 7 mm. wide; lower lip very broad, deeply 3-parted, each part 4 mm. across: stamens 4, attached near the base of the tube, included, the longer pair of filaments obliquely dilated at apex, 3 mm. long, the shorter pair a little more than 2 mm. long, scarcely dilated at top; anthers perfect and 2-celled: style stout, hairy, sparingly glandular, 3 mm. long, about twice the ovate ovary: fruit and seeds unknown.

Collected near Fresno, California, on ploughed river bottom-land, May 15, 1904, by Mr. Charles E. Jenney. It comes nearest to *A. leptaleum* Gray, but is widely different in all its parts. The peculiar apices of the leaves readily distinguish it from all other species.

Collinsia brachysiphon sp. nov.

Stems low, 4–6 cm. high, branching generally from all the leaf-axils even the cotyledons, almost glabrous below, the inflorescence puberulent and slightly glandular: cotyledons oblong-spatulate, the blades about as long as the petioles, together 15 mm., entire, obtuse, glabrous except for the puberulent petioles; upper leaves linear-lanceolate, tapering to a sessile clasping base, 1–3 cm. long, 2–4 mm. wide, obtuse, entire, in two or three pairs: from the top pair of leaves spring two or three flowers on slender pedicels that become nodding in fruit, also a corymb containing few flowers which apparently become verticillate in fruit, with linear-subulate bracts: calyx-divisions lanceolate-subulate, obtuse, slightly unequal, 2.5 mm. long, thickened at the apex and on the margins, almost twice as long as the campanulate tube: corolla small, purple, the tube 1 mm. long and a little wider, the gibbous throat twice as long as wide; upper lip deeply cleft with oblong, rounded spreading lobes; lower lip with the lateral divisions almost twice as long as the obtuse keel, darker in color: stamens with small cordate anthers and glabrous, filiform filaments; abortive stamen small, sessile, yellow: ovary conical, tapering to the style, which is 4 mm. long: capsule slightly surpassing the calyx, globular, acuminate at apex, minutely papillate: seeds 2, semi-obovate, almost 3 mm. long, completely filling the cavity, minutely papillate.

Collected by the author at Summit, Placer County, California, June 8, 1898. It differs from *C. parviflora* Lindl., which grew in thesame locality, in leaves and inflorescence, and in color and shape of corolla; and the gland-like, yoke-shaped protuberance at the opening of the throat of *C. parviflora* is replaced by a wart-like protuberance at the base of the lateral divisions. *Collinsia inconspicua* Congdon is also related, but is a much larger plant, having the corolla of a different shape and color, the calyx-lobes longer and the inflorescence different.

Chrysoma Merriami sp. nov.

Low, spreading, suffrutescent, glandular-punctate: leaves crowded, obovate, sessile, entire, 1.5 cm. long, 1 cm. wide, callous-mucronate at apex, acuminate at base, rather thick, the midvein only plainly evident: heads few, but closely clustered at the ends of the branchlets on short, bracted pedicels, the entire cluster almost sessile; bracts small and thick, orbicular to spatulate, less than 1 mm. long: heads rayless, 1 mm. long; involucre turbinate, the scales in several series, the outer successively shorter, merging into the bracts, glandular, linear, acute, less than 1 mm. long; inner 5 mm. long, keeled and tipped with brownish-green, membraneously margined, the acute apex ciliate, somewhat recurved-spreading in anthesis: corolla glabrous, tubular, gradually tapering from a slender base, 5 mm. long, teeth acute with thickened margins that become striae on the tube: anthers exserted 2 mm., the tips sharply pointed: style-branches hairy, exserted: akenes slender, 2.5 mm. long, clothed with upwardly-appressed silky white hairs; pappus about as long as the corolla, minutely barbellate.

Collected by Dr. C. Hart Merriam at Caliente Creek, Kern County, California, October 12, 1902, and named in his honor. It is nearest to *C. cuneata* Greene, differing chiefly in larger leaves and heads, and less densely hairy akenes.

Chrysoma fasciculata sp. nov.

Suffrutescent, viscid throughout except on the older stems: leaves fascicled, terete, mucronate, 1–1.5 cm. long: branchlets terminating in 1–4 heads on short, bracted peduncles: heads 1–1.5 cm. high, about 20-flowered, the 1–2 rays entire or deeply toothed; involucral scales in several series, the outer successively shorter, spreading and somewhat recurved; outermost 2–3 mm. long, green tinged with brown, glandular; inner linear, acute, 8 mm. long, brownish-green, glandular, membranously margined, apex erosely ciliate; disk-flowers tubular, gradually enlarging, the lower part glandular, upper part glabrous, striate, teeth 5, triangular with thickened margins and tips conniving around the slender hairy exserted style-branches: stamens included: akenes 5 mm. long, densely clothed with silky-white, loose, upwardly-appressed hairs; pappus subrufous, abundant, 1 cm. long, minutely barbellate.

Collected along the coast near Monterey, California, by Dr. E. K. Abbott, August 25, 1904, also the same year by Dr. C. Hart Merriam on Carmel Bay, October 11. The heads are larger than any of the genus. Externally it most resembles *Chrysoma pinifolia* (Gray) Greene, but the corollas are shaped differently, *C. pinifolia* having the teeth recurved-spreading and with almost glabrous akenes. Dr. Merriam reports it as extremely abundant, growing amid such shrubs as *Eriogonum fasciculatum*, *Lupinus Chamissonis*, and others found in similar situations.

Raillardella scabrida sp. nov.

Stems several from a thick, woody root, about 2 dm. high, leafy, scabrous with bristly pubescence, the upper part beset with black, stipitate glands: leaves alternate, linear, obtuse, sessile, 10–15 mm. long, 1–4 mm. wide, the lower ones cinereous from the white bristles thickly clothing the scabrous surface, uppermost dark from the blackish glands: heads solitary or more often 2 or 3 terminating the stems, the middle peduncle almost naked, the lateral with few bracts near the base, both rough with the dark glands, about 6 cm. long: heads eradiate, 15 mm. long; involucral scales linear-lanceolate, acute, scabrous and glandular, densely white-ciliate along the upper half, 8 mm. long, 1.5–2 mm. wide, reflexed-spreading to the very base, in fruit becoming convex on the outer side; outer flowers fertile, inner mostly sterile: corolla yellow, tubular, 6 mm. long, less than 1 mm. in diameter, uniform, the teeth with thickened margins: anthers surpassing the corolla: styles with long, slender exserted bristly tips: pappus-bristles plumose, the shaft of the feather flat, as long as the corolla-tube; akenes black, densely clothed with white, closely appressed hairs, broadening towards the top, keeled on one side, flattened and ribbed on the other, about 6 mm. long: receptacle flat, dotted at intervals with the circular scars left by the fallen akenes.

Type collected on Snow Mountain, California, August 25, 1892, by Mrs T. S. Brandegee. It is related to *R. Muirii* Gray, and seems so unlike the other members of the genus as to justify the section and almost a distinct genus.

Hieracium Grinnellii sp. nov.

Perennial with fleshy-fibrous roots: stem paniculately branched, few-leaved, slender, 6 dm. high: radical leaves forming a somewhat rosulate cluster at base of stem, oblanceolate, tapering to a broad petiole, densely clothed with long, white, barbellulate woolly hairs, repand-denticulate or entire, obtuse or acute, blade and petiole together 5–8 cm. long, viscid and hairy; cauline leaves few, linear-acuminate, diminishing upwards, sessile, entire or with two or three barely perceptible teeth, 2–4 cm. long, 2–5 mm. wide, tomentose-puberulent and somewhat glandular: panicle with few, widely spreading branches; heads few, on spreading pedicels 1–3 cm. long; bracts almost filiform, especially the short ones below the involucres, glandular-puberulent: heads 15 mm. high, the scales of the involucre in three series, the outer less than half as long as the inner, linear-attenuate, densely glandular-hairy, inner scales 1 cm. long: rays yellow, 8 mm. long, tipped with 4 narrow teeth: styles glandular, conspicuously exserted; stigmas short: pappus about as long as the involucre, barbellulate, white but slightly tawny at base, glabrous.

Type collected at Arroyo Seco near Pasadena, California, Sierra Madre mountains, December 22, 1903, by Fordyce Grinnell, Jr., in whose honor it is named. It is related to *H. argutum* Nutt. and *H. Parishii* Gray. It has the habit of *H. albiflorum* Hook., but the yellow rays of the other two species.

Lessingia albiflora sp. nov.

Divaricately spreading like a tumble-weed, about 1.5 dm. high and 3 dm. across: radical leaves dried so as to be unrecognizable but with traces of tomentum, stems and cauline leaves glandular-punctate: ultimate branchlets slender, rigid, straight: leaves induplicate, cordately clasping, ovate-acuminate, sometimes slightly aristate, the uppermost merging into the bracts, the margins edged with short tack-shaped glands, the lower leaves 8 mm. long, 4 mm. wide, recurved: branchlets terminating in one or two small heads, 8 mm. high on very short, closely-bracted pedicels: involucral scales in several series, the outer successively shorter and merging into the bracts, about 1 mm. long, green and glandular except at the chartaceous base, the inner linear, keeled, 4 mm. long, white or purplish, chartaceous except for the green, glandular spot at the triangular-acute apex, the glands all tack-shaped: flowers white, about 8 in each head: akenes obconic, densely pubescent with upwardly appressed hairs: pappus rather coarse, rufous, barbellate, unequal, the longest bristles about equaling the corolla-tube.

Collected by the author near Rose Station on the road between Tejon Pass and Bakersfield, Kern County, California, October 3, 1894. It is distinct from all other species in habit and color of flowers, but in general seems most like *L. glandulifera* Gray.

CALIFORNIA ACADEMY OF SCIENCES.

A new Botrychium from Jamaica*

William Ralph Maxon

(With plate 6)

The systematic status of the members of the group of *Botrychium ternatum* has been the subject of a good deal of comment within the past ten years. Naturally there have developed legitimate differences of individual judgment and interpretation: and, while in one or two instances the results offered have been such as to suggest doubt that the author was in actual possession of some of the forms under discussion, it is probably true that no two students working with the same series of specimens would arrive at conclusions absolutely identical. It becomes often an exceedingly difficult matter to decide whether a given series of plants — and too often a small series — constitutes a sufficiently marked and coherent assemblage to stand apart, specifically distinct, from an obviously related form; or, whether, on the other hand, it is to be regarded as a mere local variation induced, it may be, by habitat.

Of the so-called species recently recognized,† several — and they are, in the opinion of the writer, very few in number — do not appear to be valid species in the ordinary sense of the term: they lack distinctive diagnostic characters and pass insensibly into another form. And, it must be confessed, a study of the entire group must of necessity be more truly comparative and involve a wider view than is usually to be required in most groups of pteridophytes. But the fact remains, that there *are* distinct groups, inhabiting definitely restricted areas and comprising individuals in close agreement in habital and foliage characters, which offer comparatively small but absolute differences from allied groups of individuals from other regions; and it appears to the writer that, unless reduction of the most sweeping sort is to be made, it is

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† Underwood, An index to the described species of *Botrychium*. Bull. Torrey Club 30: 42–55. Ja 1903.

undoubtedly the most logical proceeding to recognize these as species and to designate them as binomials. The recognition of subspecies implies or ought to imply the existence of specimens showing the transition from the typical form to the subspecific center of variation. In two or possibly three instances among the recently recognized "species" referred to above, such intermediates seem to exist, and the writer hopes to discuss these later at greater length; but in the majority of cases intermediates (if existent at all) have not found their way into the herbaria, and the supposed justification for the reduction practiced by several American writers appears to be contained in the fast disappearing fallacy that the sum of the differences and not their constancy is the criterion for specific segregation, — a logical pursuit of which principle would lead by no very circuitous route to the treatment accorded the group by Hooker and Baker.

The plant here to be described is not associable specifically with any described form. It may very appropriately bear the name of one whose studies must necessarily prove largely instrumental in a final elucidation of this perplexing group.

Botrychium Underwoodianum sp. nov.

Plant of large stature (3 dm.), to be placed between *B. Jenmani* and *B. decompositum* of the *ternatum* group. Roots copious, stout, cordlike, corrugate above, fasciculate from a short (1–2 cm.) underground prolongation of the axis: common stalk short (about 2 cm.), bud densely covered with a compact growth of silky hairs: sterile division short-petiolate (5–10 cm.), 12–20 cm. broad and nearly as long, commonly pentagonal in shape, tripinnate, the basal pinnules of the lowermost lateral divisions usually much elongated and again deeply pinnatifid; ultimate segments relatively very large, bluntly obovate or broadly spatulate, the margins evenly and finely crenate-dentate with an occasional shallow lobation; texture slight, resembling that of *B. obliquum*; venation manifest: sporophyl about 30 cm. long; panicle rather lax, about 8 cm. long, bipinnate; sporangia large, sessile.

JAMAICA. — Type in the herbarium of the New York Botanical Garden, Jenman collection. Co-type in the U. S. National Herbarium (*no. 521103*). Of the several specimens collected by Jenman only one is fertile; and thus, though smaller than usual and less characteristic in the outlines of the sterile division, is here figured as the type. Other Jamaican specimens are: *Underwood 179* and *2620*, *Maxon 1573*, and *D. E. Watt* (U. S. N. M. *520982*), all from the vicinity of Cinchona, altitude about 1500 meters; and two specimens in the herbarium of Capt. John Donnell Smith, communicated by Hart. The last, though indicated by Dr. Christ as representing a new species, were not described, presumably on account of their immature condition.

The series at hand indicates that *B. Underwoodianum* is one of the most distinct species in the *ternatum* group. As stated, it appears to be most nearly related to *B. Jenmani* Underw.* and *B. decompositum* Mart. & Gal.† From the former it differs conspicuously in its greater size and more delicate texture; and from the latter imperfectly known species very noticeably in the following distinctive characters: (1) the peculiar shape and spacing of the segments, and (2) the wide divergence of the main divisions which spread ordinarily at an angle of nearly or quite ninety degrees, There is, moreover, in most specimens so pronounced a basiscopic development of the first lateral division as to give a decided pentagonal shape to the leaf, though this feature is not especially noticeable in the type specimen.

The type measures 13 cm. in width; others 20 cm. The illustration is at two thirds natural size and represents the type, therefore, on the printed page at less than one half the actual dimensions frequently attained by individuals of this species.

The small figure at the right represents a bud (exposed) in the enveloping hollow base of a sterile plant (Jenman collection). The upper bud is quite the same and is produced upon nearly all the sterile plants at a point from which the sporophyll would normally have had its origin.

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* Fern Bull. **8**: 59. 1900. (Type from Jamaica.)

† Mém. Acad. Sci. Brux. **15**[5]: 15. *pl. 1.* 1842. (Type from Mexico.)

Explanation of plate 6

BOTRYCHIUM UNDERWOODIANUM sp. nov.

Type specimen, at two-thirds natural size. The detailed drawing showing buds is from a second specimen in the Jenman collection; two-thirds natural size.

Notes on the zygospores of certain New England desmids with descriptions of a few new forms

Joseph Augustine Cushman

(With plates 7 and 8)

While desmids in their ordinary vegetative condition are very common, they are much less frequently found in conjugation. When found in this condition their characters are always worthy of notice. The zygospores of a considerable number of American species have been figured by Wolle and a few by later writers on American desmids, but there are many species of which the zygospores are as yet unknown. In many cases the figures given by Wolle have been found inaccurate by later writers. The formation of zygospores, aside from its comparative rarity, is always an interesting process. There appear to be various stages in the formation of the spines, as well as other characters, which need more attention to be fully understood.

A close study of the zygospores of various desmid groups should reveal something concerning relationships and should determine somewhat the validity of one or the other of the two classi-classifications, one based on form alone, the other on arrangement of cell-contents. This should be especially true in the relationships of various groups within the genus. On the other hand, certain species which are almost exactly alike both in external form and structure of contents have zygospores which are widely different in character. Whether such forms should be separated on the basis of differences in the character of their zygospores, representing fruiting conditions, or should be kept close together on the basis of similar form and structure in their vegetative state, is a question to be settled by extended work upon the zygospores of a considerable number of species.

Whether the zygospores of a single species are always constant in their characters is also somewhat of a question. If they are not constant, their use as a basis for any sort of division is at once seen to be valueless.

The following forms were found in collections made at Pondville, in May, 1903; South Framingham and Reading, Mass., May, 1904. The first two collections were made by the writer, and the last by Mr. G. A. Fisher.

CLOSTERIUM DIANAE Ehrenb. PLATE 7, FIGURES 1–3.

In the series shown, certain definite steps are represented. In *fig. 1* the two cells have each broken apart and their contents extruded and united. At this stage it consists of two portions: an outer clear, hyaline mass and an inner more dense portion with many chlorophyl-granules and oil-globules. The outer margin of the clear mass forms a perfect sphere. In the breaking of the cells in the beginning there may be three conditions. They may open as in *fig. 1*, but leaving no definite line of breakage across the cell, looking at first glance as if it were more of a stretching than an actual break. This condition was frequently noted.

In the second condition, as in *figs. 2* and *3* (the lower cells), there may be a definite break in the middle, but the two parts remain attached to one another. In the third case, as in the upper cell of *fig. 3*, the two portions become entirely separated. This last stage is interesting when compared with the following species.

In the next stage in the formation of the zygospore (*fig. 2*), the mass containing the chlorophyl is gathered together at the center, forming a spherical mass about which the hyaline portion forms an outer covering. At this stage it is considerably smaller than at first (*fig. 1*). In the final stage the chlorophyl mass remains about the same size as in *fig. 2* and the outer portion forms a thickened wall.

Specimens in all these three stages were very common in the material collected by Mr. Fisher at Reading.

Diameter of the completed zygospore, 36–40 μ.

CLOSTERIUM LINEATUM Ehrenb. PLATE 7, FIGURES 4–6.

In this species there are two things of especial interest when compared with the foregoing. The cells are completely separated and the semicells resulting adhere in a peculiar manner to the outside of the hyaline mass, extending directly outward from the surface. This condition is more like the third case mentioned under *Closterium Dianae*, but there the semicells do not adhere in the peculiar manner of this species. Wolle does not show this character in either of his figures of fruiting specimens of this species. All the specimens seen had this character.

The second character is the variation in the production of either single or twin zygospores, the latter condition being much the more frequent. With the exception of the above characters the stages are comparable to those seen in the preceding species. Fruiting specimens of this species were also abundant in the collection from Reading.

Diameter of completed zygospore, 78 μ.

MICRASTERIAS PAPILLIFERA Bréb. PLATE 7, FIGURES 7, 7a.

The zygospore of this species was figured in Ralf's British Desmids, and that I believe is the only original figure of the species in its fruiting condition. The zygospore is large with fairly large and stout spines, many of them bifurcate at the tip. Just before the spore is fully formed there is a gelatinous covering which extends partway out upon the spines. This disappears as the zygospore reaches completion, entering probably into the formation of the covering. The form of the zygospore is not exactly spherical, but slightly elongated.

Lat. zyg. s. sp. 75 μ; c. sp. 95 μ; long. zyg. s. sp. 75 μ; c. sp. 103–105 μ.

Common in the material from Reading.

PENIUM CLEVEI CRASSUM W. & G. S. West. PLATE 7, FIGURE 8.

This variety was found to be common in the material from Pondville, making the first record for it in America. The zygospore both of the typical form and of the variety has hitherto been unknown. It is spherical with numerous, broad, squarely truncated spines as in the figure. The cells in the figure have not the roughened apices which, however, they do possess in the specimens.

Long. cell. 80–84 μ, lat. 40–44 μ: diam. zyg. c. proc. 68–78 μ, s. proc. 54–57 μ.

Cosmarium pseudoorbiculatum sp. nov. PLATE 7, FIGURE 9.

This species has been confused with *C. orbiculatum* Ralfs. It is evidently the same as that figured and described by Delponte as *C. orbiculatum* (Memor. R. Accad. Sci. Torino II. **28**: 11 (107). *pl. 7, f. 46–48.* 1877), agreeing exactly in form and size. The form of the semicells is more oval in front and end view than in Ralfs' species and may in this way be best distinguished. But the zygospore is very different, holding a place distinctly apart from the usual type of *Cosmarium* zygospore. That of *C. orbiculatum* is spherical with the usual type of short conical spines. In the present species it is a decided oblate spheroid, on one end evenly convex, on the other concave in the middle forming a distinct pit of considerable size. The zygospore has from sixteen to twenty lamellar plates extending from pole to pole, evenly scalloped, each plate with about ten spines broadly elliptical at the base, becoming circular at the broadly truncated apex. The portions between the lamellae are indistinctly striate. Altogether this forms a very curious type of zygospore for this group.

Long. 40 μ, lat. 28 μ, lat. isthm. 6.5 μ, crass. 21.5 μ.

Long. zyg. c. sp. 34 μ, lat. zyg. c. sp. 50 μ.

Common in fruiting condition at Pondville, Mass.

Sphaerozosma readingensis sp. nov. PLATE 7, FIGURES 10, 10*a*.

Sphaerozosma, smooth, without exterior ornamentation, sinus deep, somewhat gaping, end view broadly elliptical, semicells in side view nearly circular, in front view nearly three times as wide as long; cells connected by two glandular processes with a third projection between them in the middle of the end of the semicell (*fig. 10a*).

Zygospore much like that of *S. Aubertianum* figured by W. and G. S. West, with fairly long acicular spines.

Lat. cell. 28 μ, long. 22 μ, lat. isthm. 6.5 μ.

Lat. zyg. s. sp. 25 μ, lat. zyg. c. sp. 52 μ.

Common in the collection from Reading, Mass.

STAURASTRUM BREVISPINUM Bréb. PLATE 8, FIGURES 12, 13.

In *figure 12* is shown an early stage in the formation of the zygospore. There is a central mass, green in color, surrounded by an outer hyaline covering. At the stage figured this consists of two distinct portions, the inner one of which evidently becomes the main wall of the zygospore, while the outer one is used up in the development of spines.

Figure 13 shows the completed zygospore of the same species.

Lat. cell. c. sp. 38 μ, s. sp. 32 μ, lat. zyg. s. acul. 32 μ, lat. zyg. c. acul. 72 μ.

This species was very common in a fruiting condition at South Framingham, Mass.

Staurastrum brevispinum basidentatum var. nov. PLATE 8, FIGURE 11.

Differs from the typical form in having three teeth at the base of each semicell. The zygospore is much like that of the usual form (*fig. 13*), but is somewhat smaller and has fewer spines.

Frequent at Pondville, Mass.

STAURASTRUM DILATATUM Ehrenb. PLATE 8, FIGURE 14.

The small specimen here figured seems best referred to this species. The zygospore is elliptical, covered with rounded protuberances. Whether this was the completed form of the zygospore or not was not fully determined.

Lat. cell. 22 μ, long. zyg. 28 μ, lat. zyg. 22 μ.

This small species was found in a fruiting condition at Reading, Mass.

STAURASTRUM GRANDE Bulnh. PLATE 8, FIGURE 17.

Figure 17 represents the typically punctate form of this species. The zygospore is large, angular, with broad, often somewhat curved spines, scattered sparsely over the surface. As far as I am aware the zygospore of this species has not been figured.

Lat. cell. 65–85 μ, lat. isthm. 12–14 μ: lat. zyg. s. sp. 60 μ, lat. zyg. c. sp. 100 μ.

Found occasionally in the collection from Reading, Mass.

Staurastrum grande glabrum var. nov. PLATE 8, FIGURES 15, 16.

This variety is much like the typical form, except that it is entirely smooth, lacking the punctate character of the former. It is slightly smaller than the typical form and is at once distinguished from var. *rotundatum* W. & G. S. West which differs from it in shape.

The zygospore of our variety is considerably different from that of the typical form. It is of about the same size, but much less angular and more densely set with shorter and more slender spines.

Figure 15 shows an early stage in the formation and *figure 16* the completed zygospore.

Lat. cell. 55–62 μ, lat. zyg. s. sp. 59 μ, c. sp. 84 μ.

This variety was much more frequently found than the typical species in the material collected by Mr. Fisher at Reading, Mass.

Staurastrum polytrichum readingense var. nov. PLATE 8, FIGURES 18, 18*a*.

This variety differs from the typical form in being more densely set with smaller and shorter spines. In other characters it is much the same.

The fruiting condition of this species has, I believe, not been figured. The zygospore of this variety is a peculiar one. It is in the main spherical and is thickly set with spines having a broad base and a trifid apex each portion of which is bifurcated. The whole zygospore including the spines is thickly set with large elongated granules giving a peculiar appearance, especially to the spines. The detail of a single spine showing this condition is given in *figure 18a.*

Lat. cell. 52 μ, lat. isthm. 16 μ: lat. zyg. s. sp. 53 μ, lat. zyg. c. sp. 78 μ.

Found at Reading, Mass.

STAURASTRUM EUSTEPHANUM (Ehrenb.) Ralfs. PLATE 8, FIGURES 19, 19*a*.

The zygospore of this species has, I think, never been figured. It is spherical in form with many processes, fairly wide at base, but on the whole slender. Near the top it divides into three branches, each one of which is again divided and the tips of the divisions bifurcate.

Lat. zyg. s. proc. 45 μ, c. proc. 84 μ.

Found both at Pondville and at Reading, Mass.

Wolle figures three distinct forms of this species. One of these (*pl. 59, figs. 4–6*) is smaller than the typical form with "spreading swallowtail-like ends of processes." This may be called var. **minnesotense** *nobis.* He also figures another variety (*pl. 59, fig. 11*), with elongated processes. This variety may be called var. **Wolleanum** *nobis.*

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Explanation of plates 7 and 8

PLATE 7. × 220

FIGURES 1–3. *Closterium Dianae* Ehrenb.
FIGURES 4–6. *Closterium lineatum* Ehrenb.
FIGURES 7, 7*a*. *Micrasterias papillifera* Bréb.
FIGURE 8. *Penium Clevei crassum* W. & G. S. West.
FIGURE 9. *Cosmarium pseudoorbiculatum* sp. nov.
FIGURES 10, 10*a*. *Sphaerozosma readingensis* sp. nov.

PLATE 8. × 450

FIGURE 11. *Staurastrum brevispinum basidentatum* var. nov.
FIGURES 12, 13. *Staurastrum brevispinum* Bréb.
FIGURE 14. *Staurastrum dilatatum* Ehrenb.
FIGURES 15, 16. *Staurastrum grande glabrum* var. nov.
FIGURE 17. *Staurastrum grande* Bulnh.
FIGURES 18, 18*a*. *Staurastrum polytrichum readingense* var. nov.
FIGURES 19, 19*a*. *Staurastrum eustephanum* (Ehrenb.) Ralfs.

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(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Bailey, W. W. What winter shows. Am. Bot. **7**: 81–83. [Ja 1905.]

Barnes, C. R. The theory of respiration. Science II. **21**: 241–252. 17 F 1905.

Bartlett, H. H. A new *Juncus* of the group *Poiophylli.* Rhodora **7**: 50, 51. 29 Mr 1905.

J. monostichus sp. nov., from Indiana.

Bayer, A. Beiträge zur systematischen Gliederung der Cruciferen. Beih. Bot. Centralb. **18**[1]: 119–180. *pl. 4, 5.* 1905.

Bessey, E. A. A nematode disease of grasses. Science II. **21**: 391, 392. 10 Mr 1905.

Blanchard, W. H. The bear blackberry. Am. Bot. **7**: 85–87. [Ja 1905.]

Brown, N. E. *Cotyledon elegans.* Curt. Bot. Mag. IV. **1**: *pl. 7993.* 1 Ja 1905.

Native of Mexico.

Christman, A. H. Sexual reproduction in the rusts. Bot. Gaz. **39**: 267–275. *pl. 8.* 18 Ap 1905.

Cogniaux, A. *Orchidaceae* — IX. Flora Bras. 12⁷: 197–390. *pl. 43–79.* 1 Mr 1905.
There are new species in *Dipteranthus*, *Gomeza*, and *Oncidium* (3).

Conard, H. S. The Olympic Peninsula of Washington. Science II. **21**: 392, 393. 10 Mr 1905.

Conard, H. S. The waterlilies: a monograph of the genus *Nymphaea*. i–xiii. 1–279. *pl. 1–30* + *f. 1–82.* Washington, 1905.
Carnegie Inst. Wash. Publ. No. 4.

Copeland, E. B. *Fungi* esculentes [*sic!*] philippinenses. Ann. Myc. **3**: 25–29. 28 F 1905.
Descriptions of 21 new species in 5 genera.

Cushman, J. A. Localized stages in common roadside plants. Am. Nat. **38**: 819–832. *f. 1–48.* 10 Ja 1905.

Evans, A. W. Notes on New England *Hepaticae*,—III. Rhodora **7**: 52–58. 29 Mr 1905.

Fernald, M. L. An undescribed northern *Comandra*. Rhodora **7**: 47–49. 29 Mr 1905.
C. Richardsoniana sp. nov.

Foster, A. S. In a Washington marsh. Am. Bot. **7**: 87, 88. [Ja 1905.]

Ganong, W. F. On balls of vegetable matter from sandy shores. Rhodora **7**: 41–47. 29 Mr 1905.

Grout, A. J. Mosses with a hand-lens. Second edition, revised, enlarged, and including the hepatics. i–xvi. 1–208. *pl. 1–39* + *f. 1–118* + *f. 1–33.* New York, [Mr 1905.]

Hall, J. G. Vegetative reproduction of *Spiranthes cernua*. Rhodora **7**: 49, 50. 29 Mr 1905. [Illust.]

Harper, R. M. Phytogeographical explorations in the coastal plain of Georgia in 1903. Bull. Torrey Club **32**: 141–171. *f. 1–5.* 19 Ap 1905.

Haynes, J. A. The angle of deviation from the normal vertical position at which stems show the strongest geotropic response. Am. Nat. **39**: 77–85. *f. 1.* 23 Mr 1905.

Hemsley, W. B. *Nicotiana Forgetiana.* Curt. Bot. Mag. IV. **1**: *pl. 8006.* 1 Mr 1905.
A new species, native of Brazil.

Hemsley, W. B. *Romneya trichocalyx.* Curt. Bot. Mag. IV. **1**: *pl. 8002.* 1 Mr 1905.
Native of California.

Hemsley, W. B. *Yucca guatemalensis.* Curt. Bot. Mag. IV. **1**: *pl. 7997.* 1 F 1905.
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Livingston, B. E. Notes on the physiology of *Stigeoclonium.* Bot. Gaz. **39**: 297–300. *f. 1–3.* 18 Ap 1905.

Lovell, J. H. Color changes in individual flowers. Am. Bot. **7**: 83–85. [Ja 1905.]

Lyon, H. L. The embryo of the angiosperms. Am. Nat. **39**: 13–35. *f. 1–11.* 20 F 1905.

Macbride, T. H. The Alamagordo desert. Science II. **21**: 90–97. 20 Ja 1905.

Macbride, T. H. The Alamagordo desert. 1–15. [1905.]

Metcalf, M. M. Determinate mutation. Science II. **21**: 355, 356. 3 Mr 1905.

Moore, G. T. Applied botany and its dependence upon scientific research. Science II. **21**: 321–333. 3 Mr 1905.

Pearl, R. Note on variation in the ray flowers of *Rudbeckia.* Am. Nat. **39**: 87, 88. *f. 1.* 23 Mr 1905.

Peet, L. H. Trees and shrubs of Central Park. i–xii. 1–363. New York, [22 Mr 1905.] [Illust.]

Rick, J. *Fungi* austro-americani fasc. II. Ann. Myc. **3**: 15–18. 28 F 1905.

Robinson, B. L. A well marked species of *Sparganium.* Rhodora **7**: 60. 29 Mr 1905.
S. fluctuans sp. nov.

Rolfe, R. A. *Catasetum Christyanum.* Curt. Bot. Mag. IV. **1**: *pl. 8007.* 1 Ap 1905.
Native of Brazil.

Rydberg, P. A. Studies on the Rocky Mountain flora — XIV. Bull. Torrey Club **32**: 123–138. 19 Ap 1905.
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Includes new species in *Acer, Oroxylum, Phellodendron, Arctostaphylos* (2), *Dracaena,* and *Pinus* (2).

Sempers, J. F. Fringed gentian notes. Am. Bot. **7**: 91–93. [Ja 1905.]

Shoemaker, D. N. On the development of *Hamamelis virginiana*. Bot. Gaz. **39**: 248–266. *pl. 6, 7*. 18 Ap 1905.

Skan, S. A. *Angelonia integerrima*. Curt. Bot. Mag. IV. **1**: *pl. 7999*. 1 F 1905.

Native of Brazil and Paraguay.

Sprague, T. A. Preliminary report on the botany of Captain Dowding's Colombian expedition. Trans. Bot. Soc. Edinb. **22**: 425–436. 1905.

Descriptions of 32 new species in 24 genera.

Thaxter, R. A new American species of *Wynnea*. Bot. Gaz. **39**: 241–247. *pl. 4, 5*. 18 Ap 1905.

Trow, A. H. Fertilization in the *Saprolegniales*. Bot. Gaz. **39**: 300. 18 Ap 1905.

Ward, L. F. An example in nomenclature. Science II. **21**: 110. 20 Ja 1905.

Whitford, H. N. The forests of the Flathead valley, Montana. Bot. Gaz. **39**: 99–122. *f. 1–10 + map*. 17 F 1905; 194–218. *f. 11–17*. 20 Mr 1905; 276–296. *f. 18–23*. 18 Ap 1905.

Wright, C. H. *Aechmea lavandulacea*. Curt. Bot. Mag. IV. **1**: *pl. 8005*. 1 Mr 1905.

A new species, native of Grenada, West Indies.

1-8. PLAGIOCHILA SMALLII Evans.
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15-21. LEJEUNEA FLORIDANA Evans.

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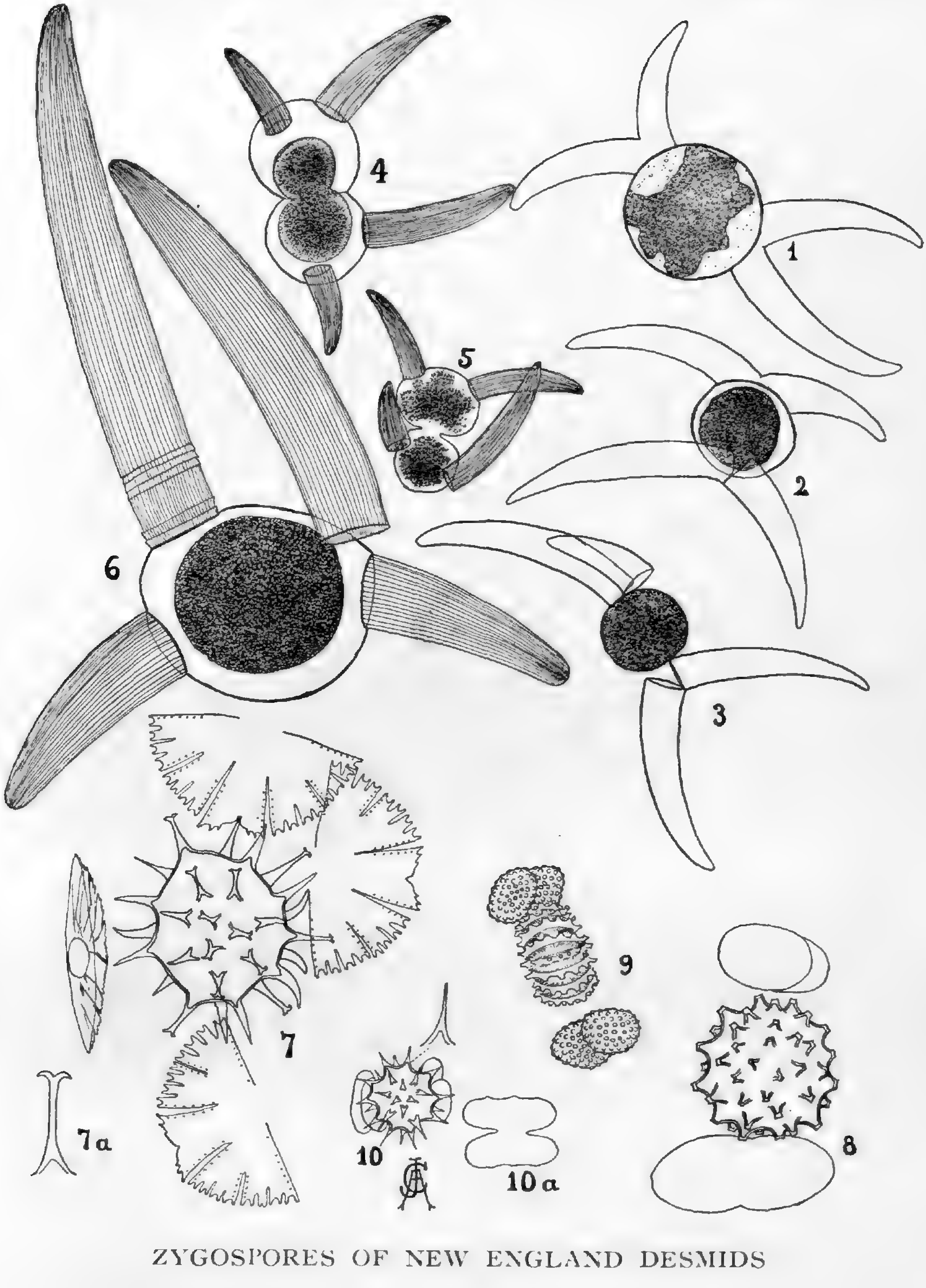

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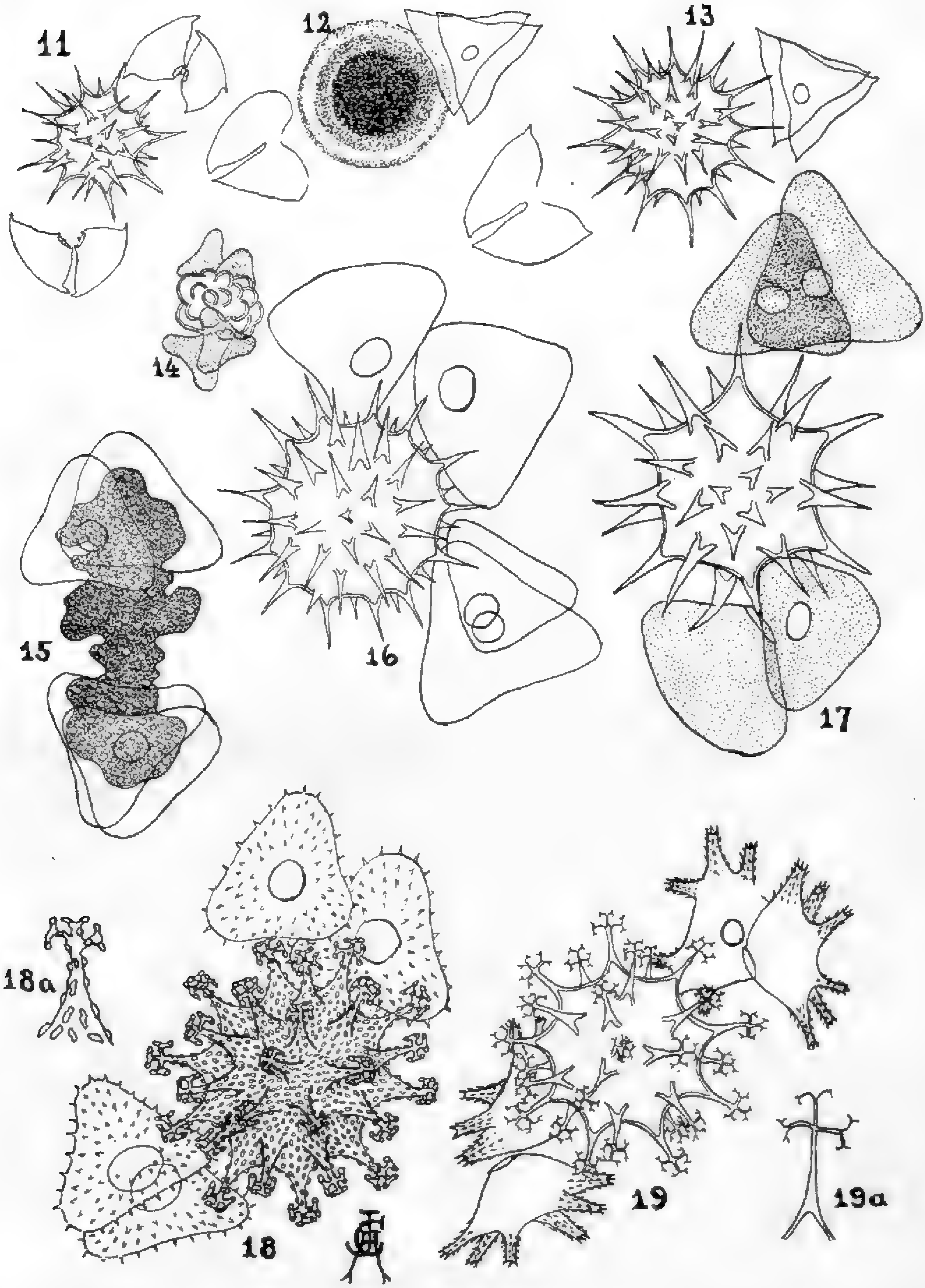

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BULLETIN
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MAY, 1905

Notes on the fruits of some species of Opuntia

James William Toumey

(With plates 9 and 10)

In the study of the species of *Opuntia* in the field, one is continually impressed by the correlation between structure and environment. The genus is, evidently, of comparatively recent origin and development. As yet no one has been able to make a satisfactory taxonomic disposition of the various species. This, evidently, is largely due to the instability of the characters which the systematist must use to separate the multiplicity of forms which comprise the genus.

A few species are known from humid regions. The genus as a whole is a desert type. Between 90 and 100 species and varieties have been described from the southwestern United States and northwestern Mexico, where they grow under the most arid conditions.

The correlation between the various organs of these plants and the environmental conditions under which they have developed is of great interest, not only to the morphologist but to the student of physiological botany as well. The fitting of form and structure to function under a desert environment has resulted in the development of organs along different lines and with different uses from those of the homologous organs of plants of more humid regions. In order to facilitate nutrition, dissemination, protection, and reproduction, under the adverse environmental conditions where the plants grow, both structure and function are highly specialized.

[The Bulletin for April (32 : 179–234) was issued 6 My 1905.]

In all species the shoot is more or less condensed and fleshy. The roots are also occasionally fleshy, as in *O. macrorhiza* and *O. filipendula*. More frequently the roots are of two sorts, long surface ones for the rapid absorption of moisture, and short deeper ones to give the plant support. The former are of quite different structure from the latter. In many species the fruit has developed along special and circumscribed lines.

Opuntia fulgida is often a tree in habit and size, and grows best in the most arid situations in southern Arizona. It seldom reproduces by natural seeding, depending almost entirely upon vegetal dissemination for its reproduction. In this species the fleshy, proliferous fruits grow in large, pendulous clusters. They are like short vegetative branches, and have few or no spines (FIG. 1). These large fruit-clusters are often sterile, and under the adverse environment the seeds that do develop usually fail to grow. The species, however, has become rapidly and widely spread through vegetal dissemination.

The fruit is usually most abundant on the lower branches and is within easy reach of cattle and other animals. Where undisturbed it remains on the trees for many months after maturing, but because of its succulency and lack of spines it is sought after by wild as well as domestic animals. In this species the ultimate branches are very succulent, densely covered with spines, two inches or less in diameter and four to eight inches long. They are very fragile, becoming detached from the plant with the slightest disturbance. Animals, in their effort to get the fruit, come in contact with them. The fragile branches become detached and adhere to the animals like large burs, finally to fall to the ground, often after being carried for miles. The basal end of the branch usually comes in contact with the soil because of the few short spines at this end, roots rapidly develop, often in the driest of weather, and a new plant becomes established.

The spineless nature of the fruit, its succulency, its growing in large clusters, its remaining attached to the plant for months after maturity and its position within easy reach of cattle and other large animals, are all important factors in vegetal dissemination. I believe that the special acquired function of the fruit as an aid in vegetal dissemination is gradually influencing its character and form. It is certainly changing from its original seed-bearing condition to one of sterility.

Plants of this species are occasionally observed bearing clusters of short spineless branches which externally closely resemble the clusters of proliferous fruits. These clusters of branches serve the same purpose as the fruits in attracting animals. It is possible that they have developed because of the intimate relation between animal life and vegetal dissemination. The fruit is caulome in structure and through its specialized use is gradually becoming sterile. In instances where the flowers have failed to develop we find these clusters of short fruit-like branches. They differ from the ordinary ultimate branches only in form, size, and want of spines.

In a number of species, specialized branches are developed which are themselves disseminated, *i. e.*, they do not aid in the dissemination of the normal ultimate branches as in *O. fulgida*. In *O. tetracantha*, *O. leptocaulis*, *O. arbuscula*, and other species with long, slender shoots, the wand-like branches are not fragile. They are not readily detached from the plant and they are not disseminated through the agency of animals. Each of these species, however, develops many short, tumid, specialized branches (FIG. 2a and FIG. 3a) but little longer than the fruits. These branches become readily detached, develop roots and form new plants on coming into contact with the soil. Large numbers of these specialized branches develop during dry and adverse seasons. Under more favorable conditions they are almost entirely replaced by fruit.

From the study of the fruit of many species of *Opuntia* from the standpoint of structure, from the similarity in external appearance between the fruit and the ultimate vegetative branches and from teratological evidence as illustrated later in this paper I have been led to the following conclusions:

1. The fruit of *Opuntia* is caulome in structure.

2. Its caulome nature is probably of recent development.

3. It has become caulome by its once superior ovary receding into a vegetative branch, thus making it at present inferior.

4. The branch, which now becomes the ovary, is usually modified and ripens into the structure which we term the fruit; it may however become but little modified, resembling the ultimate branches and continuing as a vegetative part of the plant.

The usual form of the fruit of *Opuntia versicolor* is pear-shaped (FIG. 4). It usually contains a number of well-developed, fertile seeds. It is occasionally sterile, and not infrequently shows no vestige of a seed-cavity (FIG. 5). Sometimes on the same plant with the forms of fruit mentioned above are found structures which resemble the ultimate branches in almost every respect with the exception that there is a seed-cavity containing fertile seeds in the upper end (FIGS. 6, 7, 8). Are all of these structures fruit? In this case there seems to be no dividing line between vegetative branch and fruit. The seeds in developing within the branch have influenced only its upper end. Such branches, although they contain seeds, continue indefinitely as a vegetative part of the plant; often the only external evidence indicating the fruit-character of these structures is the presence of the umbilicus at the upper end.

Throughout the genus *Opuntia* the fruit in its early development bears numerous leaves in the axils of which vegetative branches as well as flowers may occur (FIGS. 1 and 9).

The fruit of the flat-stemmed species of *Opuntia* deviates farthest in form from that of the normal vegetative branch. In *O. Engelmanni* the fruit is usually more or less pear-shaped (FIG. 10). In this species as well as in a number of other flat-branched forms, the structure containing the seeds is sometimes large and flattened like the normal vegetative branches (FIG. 11). In such cases, however, the whole member does not become pulp-like, change color, and ripen in the fall. Only that part immediately surrounding the seeds "ripens" as the seeds mature, the remainder continues as a vegetative part of the plant. When the fruit is sterile it often does not ripen at all but remains on the plant for months after the normal fruits have matured. These sterile fruits occasionally produce normal flattened branches (FIG. 12) during the second season.

The following teratological evidence suggests that the present caulome structure of the *Opuntia* fruit is a successive development from what was formerly a phyllome structure. In the sterile fruit of *O. Engelmanni* (FIG. 13) there is no evidence whatever of a seed-cavity. In this fruit the style persisted for several months after the flower appeared and continued to grow until it reached a diameter several times that of the style in the normal flower. It became red in color in the late fall, like that of the normal fruit, and developed a central cavity which contained a large number of abortive ovules. In all species of *Opuntia* the large, thick style has a much swollen base; it is possible that this is the last remnant of what was once the seed-receptacle.

The adverse environmental conditions under which *Opuntia* grows is ample reason for this interesting evolution. The ovary, which possibly at one time was superior, has gradually become more and more depressed until now it is entirely enclosed in the fleshy branch.

YALE FOREST SCHOOL.

Explanation of plates 9 and 10

PLATE 9

FIG. 1. *Opuntia fulgida;* cluster of the proliferous fruits: *a*, fruits with fertile seeds and of the usual pear-shaped form; *b*, fruit much elongated, spinescent, and resembling a vegetative branch. × $\frac{2}{9}$.

FIG. 2. *Opuntia tetracantha;* section of a long, slender branch bearing a short branch and fruit: *a*, one of the short specialized branches which usually become detached at the end of the first season. × ⅓.

FIG. 3. *Opuntia arbuscula;* short section from a long, slender branch bearing a short specialized branch (*a*), and a flower (*b*). × ⅓.

FIG. 4. *Opuntia versicolor;* normal pear-shaped fruit. × ⅓.

FIG. 5. *Opuntia versicolor;* sterile fruit. × ⅓.

FIGS. 6, 7, 8. *Opuntia versicolor;* structures resembling the normal vegetative branches in external appearance, but containing the seed-cavity with perfect seeds at the apex. × ⅓.

PLATE 10

FIG. 9. *Opuntia leptocaulis;* a fruit bearing two long branches, one of which is floriferous. × ⅓.

FIG. 10 *Opuntia Engelmanni;* normal pear-shaped fruit. × ⅓.

FIG. 11. *Opuntia Engelmanni;* the seed-cavity with perfect seeds in the apex of a flattened branch. × $\frac{1}{6}$.

FIG. 12. *Opuntia Engelmanni;* a sterile fruit persisting until the second year and from which is growing a normal flattened branch. × $\frac{1}{6}$.

FIG. 13. *Opuntia Engelmanni;* a sterile fruit on which the style has persisted, continued in growth, and formed a central cavity in which are many abortive ovules.

Phycological studies — I. New Chlorophyceae from Florida and the Bahamas

MARSHALL AVERY HOWE

(WITH PLATES 11–15)

Halimeda scabra sp. nov.

Usually dark green, fading to a yellowish green on drying, strongly calcified and commonly rough to the touch, erect or ascending and forming clusters 6–9 cm. high or sometimes reclinate among other algae and reaching a length of 25 cm. : branching mostly dichotomous, usually frequent or somewhat congested, rarely sparing : segments plane, enervate, discoid, subreniform, suborbicular, or occasionally deltoid-obovate, 4–14 mm. broad, 0.6–1.5 mm. thick, margin entire : peripheral utricles hexagonal in surface view, 27–50μ in diameter, varying from subturbinate to subfusiform in lateral view, 70–240μ long, galeate, $\frac{1}{6}$–$\frac{2}{5}$ of the length consisting of the acuminate, often indurated terminal cusp; lateral walls in contact for only a small fraction of their length, easily separating on decalcification, usually somewhat thickened or gibbous at the angles of contact : filaments of the central strand fusing in twos or threes at the joints : sporangiophores 1.6–2.5 mm. long, rarely simple, mostly once or twice dichotomous, sometimes subracemose, irregularly proliferous, or in part cymose, fringing the margins of the segments or now and then scattered on the flattened faces, each commonly springing from the fusion of two central filaments; the pyriform sporangia 0.16–0.32 mm. broad, for the most part alternately distichous on the ultimate branches. (PLATES 11 and 12.)

Not uncommon on the coast of Florida and the outlying keys from Jupiter Inlet to Key West; also in the Bahama Islands. It grows on a rocky bottom or about the bases of sponges, from low-tide mark down to a depth of at least three meters. The description has been drawn from a study of thirty or more specimens, representing about as many localities, but our fertile spceimen *no. 2905* from Sands Key, Florida (March 30, 1904), which has furnished material for FIGURES 2 and 3 of PLATE 11 and for FIGURES 1, 3, 5, 7–11 of PLATE 12, we consider the nomenclatorial type.

Halimeda scabra is similar to *Halimeda Tuna* in form and habit and it occurs under the latter name in various herbaria. It can, however, be easily distinguished by the always strongly galeate-cuspidate peripheral utricles, a character which, we believe, has thus far been observed in no other species of the genus. These spines or cusps are so large that they are visible under a good hand lens in a properly lighted profile view across a segment-margin even in a dried specimen. The plant is also more strongly calcified than *Halimeda Tuna*, and the peripheral utricles are smaller in surface view and separate more readily on being decalcified. However, *Halimeda scabra* bears a stronger resemblance in outward form to the typical Mediterranean *Halimeda Tuna* than it does to a second South Floridan and West Indian *Halimeda* of the *Tuna* alliance, with which it sometimes grows associated. This second *Halimeda* is larger, always smooth, only slightly calcified, of a bright light green color and lubricous when living and more or less papyraceous on drying. Its segments reach an extreme width, so far as observed, of 35 mm.; and in general, the plant may be said to combine characters of *Halimeda Tuna platydisca* (Decne.) Barton and *H. cuneata* Hering, as these two are limited and defined by Mrs. Gepp (Miss Ethel Sarel Barton) in her admirable monograph on "The Genus Halimeda." * The lateral walls of the peripheral utricles are in firm contact for $\frac{1}{5}$–$\frac{2}{3}$ their length, as in *H. cuneata*, but the peripheral utricles measure 45–120 μ in surface view, while those of *H. cuneata* are described by Mrs. Gepp as 25–40 μ; the filaments of the central strand separate readily at the joints as in *Halimeda Tuna* instead of being coherent as in *H. cuneata*.† This plant has been met with only in a sterile condition. It seems rather violent to identify it either with *Halimeda Tuna* or with *H. cuneata*, and it is possible that further acquaintance with it will show constant and reliable characters for distinguishing it from both. The *Halimeda scabra* and the smooth plant of the *Tuna-cuneata* alliance have been more or less mixed in certain American exsiccatae. Thus, in the *no. 41*

* Siboga-Expeditie. Monographe LX. 1901.

† Mrs. Gepp alludes (*l.c.* p. 16, 17) to a specimen from Rangiroa brought by Professor Agassiz in the *Albatross*, which forms a connecting link between *H. Tuna* and *H. cuneata*, but this has the peripheral utricles of *H. Tuna* and the joint connections of *H. cuneata*.

of the Algae Exsicc. Am. Bor. of Farlow, Anderson and Eaton, issued as *Halimeda Tuna*, out of seven sets examined, three are *Halimeda scabra*, two are the smooth species, and two contain a mixture of the two species. In *no. 167* of the Phycotheca Boreali-Americana of Collins, Holden and Setchell, distributed as *Halimeda Tuna*, out of ten sets examined, eight are *Halimeda scabra*, one is the smooth *Halimeda*, and one is a mixture of the two. The plants from Jupiter Inlet distributed in Curtiss' Algae Floridanae as *Halimeda Tuna*, also include the two distinct species.

The only specimens that we have seen from Atlantic waters approaching the American shores, which seem to agree thoroughly well with the typical *Halimeda Tuna*, are from Bermuda. These we have found also in a fertile condition.

The sporangiophores of *Halimeda scabra* show a good deal of variety in mode of branching, as will appear from the above diagnosis and from the accompanying figures. A comparison with the sporangiophores of *Halimeda Tuna* as figured and described by Derbès & Solier * and by Mrs. Gepp, † and as exhibited in the Bermudian specimens alluded to above, does not seem to bring out any very important or reliable differences. Possibly the sporangia in *H. scabra* are more regularly distichous. The regular *alternation* of the sporangia in *H. scabra* is often interfered with by the suppression of one or more sporangia or by the occurrence of a cluster of two or three where we would normally expect only one, but a real interruption of the *distichous* arrangement is rarely found, while in *H. Tuna* such interruption is perhaps of more frequent occurrence. It should be noted that in *Halimeda scabra* the stalk of the well-matured sporangium shows in most cases a distinct septum or plug, cutting off, more or less completely, the contents of the sporangium from the sporangiophore. This is variable in position, but is commonly near the base of the stalk and is often accompanied by a slight constriction. The plug, which seems to consist of a callose mucilage rather than cellulose, sometimes extends throughout the length of the stalk to the base of the sporangium, in the narrower sense of the word. It is often

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*Suppl. Comptes Rendus hebdom. Séances Acad. Sci. **1**: 46, 47. *pl. 11. f. 18–22: pl. 12. f.* 1–5. 1856.

† Journ. of Bot. **42**: 193–197. *pl. 461.* Jl 1904.

traversed by a central canal, yet in some cases the lumen appears entirely closed. Some apparently mature sporangia show no trace of a septum or plug, but in such instances similar plugs can usually be found in the rhachis of the sporangiophore and it is probable that these may serve as common septa for two or more sporangia. A basal septum or plug has not been attributed to the sporangium of *Halimeda*, so far as we know; in fact, its existence has been expressly denied,* yet from analogy with *Codium* † of the same family, and perhaps we may say from analogy with the known sporangia of the Siphonales in general, its presence is what would be expected. In the fertile specimen from Bermuda, which we believe referable to *Halimeda Tuna*, the material is less well preserved and less mature and the plugs are more difficult to demonstrate, yet we have observed in this also a few undoubted instances of their presence.

We regret that the opportunity for seeing the living zoöspores of *Halimeda scabra* was not followed out. The material preserved with the aid of formaldehyde does not enable one to get a very good conception of the form and size of the zoöspores, but the protoplast of the sporangium often shows a minutely polygono-radial structure at its periphery.

Siphonocladus rigidus sp. nov.

Caespitose, subfastigiate, rigid, the cushions 2–5 cm. high, of a light translucent green when living: primary ramification mostly dichotomous or subdichotomous, the main axes often also with irregular or subsecund, lateral prolifications: filaments 350–1150 μ broad, consisting usually of a single series of cells,‡ but often, especially under the dichotomies, becoming two or three cells in width owing to longitudinal or oblique divisions: cells variable in length, mostly about as long as broad, those of

* Schmitz. Sitzungsber. d. niederrheinischer Ges. f. Natur- und Heilkunde, 1879: 143. 1880.— Wille; Engler & Prantl, Nat. Pflanzenfam. 1[2]: 140. 1890.

† Harvey-Gibson, R. J., & Auld, H. P. Codium. L. M. B. C. Memoirs, IV. 1900.

‡ We are aware that certain modern biologists object to applying the word "cell" to the segments of a coenocytic plant like *Siphonocladus*, but its use in this sense is historically and etymologically more accurate than its proposed modern restriction to the "energid" of certain physiologists. Moreover, no substitute entirely satisfactory to the systematist has been suggested. Proposed equivalents, like "segment," "compartment," and "coenocyte" are often either ambiguous or unnecessarily awkward.

prolifications sometimes 10–20 times as long; wall of filament conspicuously lamellate, 15–70 μ thick (including the enclosed, usually thinner wall of the individual cell); upper face of the diaphragms often strongly mammillose or tuberculose with lamellate elevations, these 30–50 μ broad: filaments sometimes coherent or concrescent at points of casual contact by means of small, usually oval or quadrate, fibular cells: ordinary cells often forming cysts, either as a whole or after endogenous division (PLATES 13 and 14).

Siphonocladus rigidus occurs in southern Florida and in the Bahama Islands, growing in water that is from 3 to 10 dm. deep at low tide, often in association with *Goniolithon strictum* Foslie. It is crisp and rigid when living, crunching under the collector's boot in the water somewhat like the *Goniolithon* whose society it affects. As is common in the family to which it belongs, the dried specimens give a poor idea of the living habit of the plant. Our *no. 1597* from Key West, Florida (October 30, 1902), from which the material used for the published photograph and for most of the drawings was taken, we consider the nomenclatorial type. Specimens collected under this number were distributed in the Phycotheca Boreali-Americana as *no. 1031* under the name *Siphonocladus tropicus* (Crouan) J. Ag.

Siphonocladus rigidus is probably more nearly related to *Siphonocladus brachyartrus* Svedelius,* from Magellan's Straits, than to any other described species, but *S. rigidus* is larger and coarser, the filaments measuring 350–1150 μ in thickness, while those of *S. brachyartrus* are given as but 200–300 μ, the cells are mostly even shorter proportionally than in *S. brachyartrus*, and the branching is more often and more truly dichotomous.

Siphonocladus rigidus is allied also to *S. tropicus* (Crouan) J. Ag., yet is sufficiently distinct as may be gathered from a comparison of our photograph of a fluid-preserved specimen (PL. *13*, F. *1*) with the photograph (PL. *13*, F. *2*) of the dried specimen in hb. Agardh, which was communicated by M. Mazé as "*Apjohnia tropica* Crouan" and may fairly be considered the type of the species, inasmuch as J. Agardh was the first (Till. Alg. Syst. **5**: 105. 1887) really to publish a description of it. The specimens from Florida, Barbados, and Mauritius, also cited by J. Agardh as belonging to

* Svenska Exped. till Magellansländerna, **3**: 304. *f. 3* and *pl. 18*. 1900.

that species, as well as specimens in herb. British Museum and herb. Mus. Paris., distributed by Mazé or by Mazé and Schramm as *Apjohnia tropica* Crouan, all maintain the peculiar habit of growth which reminded Agardh of *Chordaria flagelliformis* (*l. c.* p. 103). The most frequent mode of branching in *S. rigidus* is, on the whole, the dichotomous, and dichotomy, so far as we have observed, does not occur in *S. tropicus.* Occasionally, in *S. rigidus*, a fragment in which dichotomies are rare or perhaps wanting and lateral proliferations are numerous, like that illustrated in FIGURE 2, may bear a certain resemblance to *S. tropicus*, but this resemblance, we believe, is illusory,—is even less real than that of *Halimeda scabra* and *H. Tuna.* The cell-walls of *S. tropicus* are comparatively thin, measuring only 3–15 μ in thickness and the axes of the much elongated flagelliform branches are typically two or more cells broad, except at the extreme apices, while in *S. rigidus* the main branches are of a single series of cells for the greater part of their length ; in *S. tropicus*, the ultimate lateral branches are rather uniformly and radially developed, in *S. rigidus* they are somewhat secund or very irregular in length and position ; the peculiar mammillosities on the transverse walls, often conspicuous in *S. rigidus*, though not always present, we have never observed in *S. tropicus.*

In our earlier studies of *Siphonocladus rigidus* we had believed we saw the formation of zoöspores and pores for their escape through the wall of the cell, but did not succeed in finding such when the time came for drawing up the description. Cysts, however, are of common occurrence, and these may arise either by the separation and rounding off of the individual cells within the common filament sheath or by the endogenous division of these cells and the formation of new walls. The cells of the filament in the ordinary vegetative condition are rather easily separable from each other within the common filament sheath. FIG. 10 shows the result of applying pressure to the cover-slip above a filament-apex which had previously appeared transversely septate.

A curious and noteworthy feature of *Siphonocladus rigidus* is the apparently constant presence of the delicate hyphae of a fungus (?) closely appressed to its surface. These hyphae are variable in abundance, but we have never seen a branch or even a cell that was entirely destitute of them. The hyphae run, on the whole, parallel to the direction of growth of the host, either singly or laterally connate in bands of 2–4, occasionally with irregular pseudo-parenchymatous anastomoses, as shown in FIGURE 11. The hyphae are 2.5–6 μ broad, and septate, the cells being mostly 4–15 times as long as broad and each containing one or more colorless granules. No reproductive bodies have been observed. The fungus naturally suggests the epiphyte in *Blodgettia confervoides* Harv., to which epiphyte Professor E. Perceval Wright * has restricted the generic name *Blodgettia* under the binomial *Blodgettia Bornetii*, yet the two fungi are evidently different things, that on the *Siphonocladus* not only lacking the "conidia" of the other, but differing also in characters of the mycelium. Being uncertain to what extent fungus and alga may be symbiotically related, we have purposely omitted reference to the fungus in our specific diagnosis, preferring to ground the species on the alga alone. It is within the bounds of possibility that future investigations will serve to emphasize the apparent analogies of *Blodgettia confervoides* and *Siphonocladus rigidus* with the Lichenes and that some day there may be recognized a group of marine lichens in which the alga is the dominating symbiont.

Petrosiphon gen. nov.

A genus of Chlorophyceae of the family Valoniaceae.† Thallus crustaceous, lightly coated with lime, firmly adnate to the substratum by ventral rhizoids and conforming to the inequalities of its surface, composed of coherent irregularly septate tubes, these dichotomously branched or laterally proliferous as in the genus *Siphonocladus* (without septum at base of branch); the determinate progressive margin consisting of usually a single stratum of radially directed tubes, the older parts commonly showing in vertical section several irregularly superposed tubes, mostly with a radial direction, the central part, however, often consisting of vertical tubes of limited growth and nearly equal length, springing from a horizontal hypothallus. Cysts (aplanospores) frequent; other modes of reproduction unknown.

The genus *Petrosiphon* is allied to *Siphonocladus* Schmitz but

* On Blodgettia confervoides of Harvey, forming a new Genus and Species of Fungi. Trans. Roy. Irish Acad. **28**: 21–26. *pl. 2.* 1881.

† See page 250.

is sufficiently differentiated from that by its flat, compact, crustaceous, more or less calcareous thallus, with determinate outline and radio-marginal growth. The type of the genus and the only species known to the writer is

Petrosiphon adhaerens sp. nov.

Forming light-green suborbicular patches, mostly 2–6 cm. in diameter, on rocks, often irregular in outline on an irregular substratum: margins radially striate or sulcate to the naked eye both when living and when dried, everywhere most closely appressed and adnate to the substratum; older central parts sometimes attaining a thickness of 3–5 mm.; tubes mostly 300–580 μ in diameter, those of periphery often nearly straight and sparingly subdichotomous, those of older parts commonly somewhat geniculate; cells ½–20 times longer than broad, cell-walls mostly 6 to 35 μ thick, conspicuously lamellate and often showing also transverse striae on surface; vertical tubes in central portion, when well developed, springing from a comparatively thin hypothallus, this commonly consisting of a single layer of horizontal tubes transformed by the vertical elongation of nearly all their component cells: calcification strongest in the vertical contact planes, the walls in these planes remaining rigid on drying while remainder of exposed wall of surface cells collapses, the surface of thallus becoming thereby radio-sulcate toward margin and usually spongiose-alveolate toward center: special fibular cells very rare, adjacent cells, however, often connected by horn-like or subconical processes: ventral rhizoids very numerous, rock-boring, tortuous, branched, septate, mostly 9–27 μ in diameter: cysts (aplanospores) extremely variable in size and form. (PLATE 15).

Common in the Bahama Islands, growing on surf-beaten calcareous rock near low-water mark and in tide-pools. Our *no. 3322*, collected January 23, 1905, in tide-pools on Silver Cay, near Nassau, from which our published photograph was taken, we consider the type of the species.

The thicker central portions of the thallus of this plant (exclusive of rhizoids) can be readily removed from the rock with a knife, but no specimen adequately representing the thinner marginal parts can be obtained without including also the rock substratum. The delicate rhizoids described above often give a green color to the rock for a depth of 1–2 mm. They are not ordinarily seen at all unless the subjacent rock is carefully decalcified together with the plant, when they appear as a dense tomentum adhering to the lower surface of all parts of the thallus except a very narrow zone at the growing margin. They are commonly more or less intertangled with filamentous, rock-boring Cyanophyceae. The larger rhizoids are occasionally formed by a ventral evagination of a part of the thallus-tube, the lumina of the two remaining continuous, but the ordinary slender rhizoids, the measurements of which are given above, appear from an early stage to be external appendages to the thallus-tubes, their basal cells standing in about the same relation to the walls of the main cells as do the small fibular cells of *Siphonocladus rigidus* shown in PLATE 14, FIG. 4.

Like *Siphonocladus rigidus*, *Petrosiphon adhaerens* is accompanied by a fungus, or, at least, a chlorophylless filamentous thallophyte, though this is not so uniformly present as in that species; we have never dissected a thallus in which it could not be found, yet large parts are sometimes destitute of it and we are of the opinion that its relation to the alga is that of a parasite rather than that of a subordinated symbiont. The external hyphae lie somewhat loosely among the thallus-tubes or rhizoids; they are fuscous, septate, 2.5–5 μ broad (cells mostly 2–15 times as long), for the most part sparingly branched, straight or sometimes contorted or torulose; the hyphae finally penetrate the walls of the thallus-tubes and follow their cavities in the direction of their growth, meanwhile becoming lighter-colored and forming much-elongated, ribbon-shaped or virgate-fasciculate, decompound clusters of branches; the cells of these endophytic branches are mostly 5–12 μ long, ellipsoid, oblong, or ovoid, and are occupied chiefly by a large vacuole, with 1–3 small refringent bodies usually lying close to the wall. Nothing which could be identified with reasonable certainty as a reproductive body of this fungus has been observed.

The only described species, so far as we can discover, which may suggest itself as possibly congeneric with *Petrosiphon adhaerens* is the minute *Siphonocladus voluticola* Hariot, which grows on the shells of *Voluta* in Tierra del Fuego. But this, according to the original description and figures,* and according to supplementary descriptions and figures by Bornet,† is quite different and

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*Jour. de Bot. **1**: 56. 1887; Mission scientifique du Cap Horn **5**: 22. *pl. 1. f. 2–4.* 1889.

†Bull. Soc. Bot. France **36**: clix, clx. *pl. 10. f. 1, 2.* 1889.

probably generically different. It does not form a solid, coherent thallus and nothing is said of a calcareous coating. Bornet (*l. c.*, p. clix) refers this *Siphonocladus voluticola* provisionally to the genus *Gomontia*, but states that this reference is doubtful owing to the imperfect condition of the specimen.

Petrosiphon may, without serious doubt, be placed in the family Valoniaceae as that family is defined by J. Agardh * and by Wille † and perhaps also in the Valoniaceae as more recently limited by Oltmanns, ‡ even though the genus *Siphonocladus*, with which we have compared *Petrosiphon*, is by Oltmanns excluded from the Valoniaceae and made the type of a separate family, the Siphonocladiaceae. But it may fairly be questioned, we think, whether the proposed separation of the Siphonocladiaceae and Valoniaceae as distinct families is not rather difficult and unnatural. The main point of distinction, as pointed out by Oltmanns, appears to be the existence of a "Hauptstamm" in the Siphonocladiaceae, which is lacking in the Valoniaceae. The historical type of the genus *Siphonocladus*, as described and figured by Schmitz, does indeed show a "Hauptstamm," but in most of the species which have since been referred to the genus by Hariot, § Bornet, || Reinbold, ¶ and Svedelius,** the "Hauptstamm" is not readily distinguishable unless, perhaps, in the little-known early stages of growth. In the species described above under the name *Siphonocladus rigidus*, a main axis is soon lost when dichotomies occur as shown in FIGURE 1, but is evident when the branching is as shown in FIGURE 2; nevertheless, both these types of branching are sometimes found in a single tuft and represent, we believe, the variations of a single species.

The specimens from which the above descriptions of new algae have been drawn, including the actual materials which have served as a basis for the published photographs and drawings, are deposited in the herbarium and museum of the New York Botan-

* Till Alg. Syst. 5: 11, 90. 1887.

† Eng. & Prantl, Nat. Pflanzenfam. 1^2: 145. 1891.

‡ Morph. und Biol. der Algen, 1: 255, 269. 1904.

§ Jour. de Bot. 1: 56. 1887.

|| Jour. de Bot. 1: 56. 1887; De-Toni, Syll. Alg. 1: 358, 359. 1889.

¶ Hedwigia 37: (88) Beibl. 1898.

** Svenska Exped. till Magellansländerna 3: 304. *f. 3* and *pl. 18*. 1900.

ical Garden. The dissections and microscopic preparations, have, however, been transferred from the glass slides, on which they were studied and figured, to glycerine-jelly mounts on slips of mica.

NEW YORK BOTANICAL GARDEN.

Explanation of plates 11-15

PLATE 11. *Halimeda scabra*

1. Photograph of plant, seven-ninths natural size. Specimen collected near Jupiter Inlet, Florida, by A. H. Curtiss, September, 1895.

2. Photograph of portion of fertile plant, one and one-half times natural size. Type specimen, *no. 2905* (Sands Key, Florida).

3. Upper part of the same, three times natural size.

PLATE 12. *Halimeda scabra*

1. Portion of margin of segment, decalcified, in surface view, × 65.

2–6. Peripheral utricles, teased out and decalcified, in lateral view, × 150.

7. Filaments of central strand, showing mode of fusion, × 38.

8–11. Sporangiophores and sporangia; 8 and 11, × 38; 9 and 10, × 24. In Fig. 11, the prevailing distichous arrangement of the sporangia is illustrated and in the older sporangia the position of the basal septum or plug is indicated.

Figs. 1, 3, 5, and 7–11 are drawn from the type specimen, *no. 2905* (Sands Key, Florida) and figs. 2, 4, and 6 from *no.* 2978 (Caesars Creek, Florida).

PLATE 13

1. Photograph of *Siphonocladus rigidus*, natural size. From *no. 1597*, collected at Key West, Florida, October 30, 1902, and now preserved in fluid in the museum of the New York Botanical Garden.

2. *Siphonocladus tropicus* (Crouan) J. Ag. Photograph of specimen in hb. Agardh, communicated by Mazé as *Apjohnia tropica* Crouan, — ⅞ natural size.

PLATE 14. *Siphonocladus rigidus*

1. Portion of plant, showing the more usual ramification, × 5. Near *a*, contiguous branches connected by small fibular cells had been pulled apart.

2. Portion of plant with numerous lateral branches or proliferations, × 5.

3. Surface view of a somewhat similar fragment, × 5.

4. Portion showing the small fibular cells and concrescence of branches at points of contact, × 16, optical section.

5, 6. Fibular cells, × 66.

7. Diaphragm showing mammilliform or tuberculiform elevations, in optical section, × 40.

8. About one-fifth the area of a diaphragm, showing mammilliform or tuberculiform elevations in surface view, × 66.

9. Cysts resulting from the division of the protoplast of a single cell, × 16.

10. One of the filament-apices shown in Fig. 1 as it appeared after crushing under the cover-slip, × 16.

11. Hyphæ of a fungus (?), which is apparently always found on the surface of the cells of *Siphonocladus rigidus*, × 390.

Figures 1, 4–7, and 9–11, have been drawn from our *no. 1597* (Key West, Florida); figs. 2 and 3 from *no. 2771* (Cutler, Dade County, Florida) (similar branching, however, can be found in *no. 1597*); and fig. 8 from *no. 3046* (Hog Island, Nassau Harbor, New Providence, Bahamas).

PLATE 15. *Petrosiphon adhaerens*

A photograph of formalin-preserved specimens collected in tide-pools on Silver Cay, near Nassau, Bahamas, January 23, 1905 (*no. 3322*). The plants were photographed under an enlargement of 1¾ diameters in order to bring out better the radiating component tubes and this magnification is retained in the reproduction. The darker mass just below the middle of the upper right-hand plant is made up of various epiphytes.

Notes on New Jersey violets*

HOMER DOLIVER HOUSE

(WITH PLATES 16–18)

During the spring and early summer of 1904, I was able to make a collection and field study of the violets in the vicinity of New Brunswick, Middlesex County, New Jersey. Several of the species collected have not been previously reported from the state, and this, in connection with the fact that two of them have recently been described as new from Long Island,† and that many of the specimens collected are undoubted hybrids, lends particular interest to the violets of this region.

Among the acaulescent species, the following are either new to the state or deserving of special mention.

Viola Stoneana sp. nov. "*Viola septemloba* LeConte," Stone, Proc. Acad. Phila. **1903**: 678. *pl. 35. f. 2; pl. 39. f. 3.* 1903. Not *V. septemloba* LeConte, Ann. N. Y. Lyc. **2**: 141. 1828. Not "*V. septemloba* Le Conte," Brainerd, Rhodora **6**: 16. 1904.

This species, so well described and figured by Mr. Stone, can in no way be connected with LeConte's species of Georgia, Florida and Alabama. The latter is well described by Mr. Pollard ‡ in Small's recent *Flora*, and specimens from that region match well with LeConte's description and his unpublished plate, which I have been able to examine through the courtesy of Dr. E. L. Greene.

V. Stoneana is related to *V. palmata*, having about the same floral characters. The leaves, however, have a characteristic lobation and except for the ciliated margins are nearly glabrous. The capsules from the cleistogamous flowers are suberect on peduncles 5–6 cm. high. The accompanying illustration (PLATE

* Published by permission of the Secretary of the Smithsonian Institution.

† E. P. Bicknell, in Torreya 4: 129. 1904.

‡ J. K. Small, Flora of the Southeastern United States 891. 1903.

16) was made from fresh flowering plants collected near Milltown (*no. 47*).

The type of *Viola Stoneana* is Witmer Stone's *no. 5113*, collected near Kennett Square, Pa., May 7, 1903. *No. 5112*, a flowering specimen, is identical (National Herbarium numbers, *490405* and *490404*.

Material in the National Herbarium shows the range of this species to extend as far south as Virginia.

VIOLA PALMATA L. Sp. Pl. 933. 1753.

The typical form of this species, if we regard the figure and description of Britton and Brown's *Illustrated Flora*,* as typical; is rare in this region. The following varieties are more abundant than the species.

VIOLA PALMATA VARIABILIS (Greene) Stone, Proc. Acad. Phila. **1903**: 667. 1903. *V. variabilis* Greene, Pittonia **5**: 91. 1902.

Recognizable by the diversified character of lobation exhibited by the leaves and the very dense pubescence. Abundant on dry or sandy slopes and in open woods, near New Brunswick (*nos. 34, 35 and 36*). One of these with variegated flowers is the *Viola palmata variegata* G. Don.†

VIOLA PALMATA ANGELLAE (Pollard) Stone, Proc. Acad. Phila. **1903**: 678. 1903. *V. Angellae* Pollard, Torreya **2**: 24. 1902.

Found only on the hills north of Bound Brook (*no. 32*), and therefore considerably south of the Orange mountains, the type locality. The flowers are much larger and of a brighter blue than the typical *V. palmata*. Like *V. palmata*, it has various "*dilatata*" forms, and if recognized as a species, it must be upon its floral characters, which are more evident in the field than in the herbarium.

All of the subspecies of *V. palmata*, and its allies, often show forms with more or less entire or three-lobed leaves, and this in itself is the best proof of the impropriety of using "*dilatata*" as a subspecific or varietal name. The condition expressed is merely

* Britton and Brown, Illustrated Flora **2**: 446. 1897. *f. 2484*.

† Gen. Syst. **1**: 321. 1831.

a "form," and often not even that. The species or subspecies designated by Elliott * as *V. palmata dilatata*, is probably distinct from the more northern so-called var. *dilatata*.

Viola Brittoniana × cucullata hyb. nov.

Glabrous, light-green, 1.5–2 dm. tall; mature leaves triangular or triangular-ovate in outline, shallowly cordate or nearly truncate, divided into 5–9 somewhat irregular lobes, the lobes cut one-half to two-thirds of the distance to the petiole, the margins irregularly crenate-dentate; petioles two to three times as long as the blades; flowers similar to *V. cucullata*, the petals somewhat narrower; cleistogamous flowers and capsules also similar to *V. cucullata*, but the peduncles shorter.

This is apparently the same as the plant mentioned by Mr. Witmer Stone † as a possible hybrid between *V. Brittoniana* and *V. cucullata*. Its characters and habitat seem to favor such an assumption. The cleistogamous capsules are usually more or less abortive when mature and the petaliferous flowers apparently never develop capsules bearing seeds, which is the case with both *V. Brittoniana* and *V. cucullata*. The accompanying illustration (PLATE 17) was made from living plants collected near Milltown (*no. 62*, June 5, 1904, type in herb. House; and *no. 79*, June 14, 1904) and growing in close proximity to both *V. Brittoniana* and *V. cucullata*. *Viola notabilis* Bicknell,‡ described from Long Island, should also be referred to this hybrid.

VIOLA PECTINATA Bicknell, Torreya **4**: 129. 1904.

Found near Dayton, Middlesex County, in low meadows and along ditches (*no. 15*, May 10; *no. 57*, May 30, 1904). Apparently an excellent species, and notable in being discovered both on Long Island and New Jersey at about the same time. The withered petioles of former seasons are more or less persistent, the basal auricles of the sepals are short and blunt and not at all suggestive of either *V. Brittoniana* or *V. emarginata*, to which the species is apparently related. The cleistogamous flowers are sagittate, on erect peduncles 5–7 cm. long; their oblong capsules about 1 cm. long. (PLATE 18.)

* Bot. S. C. and Ga. **1**: 300. 1817.

† Proc. Acad. Phila. **1903**: 680. 1903.

‡ Torreya **4**: 131. 1904.

VIOLA NEPETAEFOLIA Greene, Pittonia **5**: 92. 1902.

A peculiar little species with elongated, deeply cordate and very narrow leaves. Found near Dayton (*no. 22*, May 10, 1904). Related to *V. affinis* LeConte, from which it differs in its leaf-characters and the densely pubescent capsules of the cleistogamous flowers.

VIOLA CONJUGENS Greene, Pittonia **4**: 3. 1899.

Found in two localities near New Brunswick and Milltown (*nos. 25 and 40*). In both instances, growing with a form of *V. fimbriatula* (*no. 24*) the leaves of which approach *V. sagittata* in shape, yet are densely pubescent. *V. conjugens* differs from it by its oblong-ovate and cordate leaves, less pubescence, and its larger flowers of a deeper violet-blue color. It is possibly a hybrid.

VIOLA FIMBRIATULA J. E. Smith, in Rees Cyclop. No. 38. 1817.
V. ovata Nutt. (1818.)

The most abundant violet of the region and also the most variable. It shows all gradations into *Viola fimbriatula aberrans* Stone,* and a close study of this variety in the field leads me to agree with Mr. Brainerd † in calling it a natural hybrid. It in turn seems to pass into *V. Porteriana* Pollard, ‡ excellent specimens of which occur at Lindenau, near New Brunswick (*nos. 54 and 67*) and, in the field, also show all indications of being true hybrids.

V. fimbriatula is subject to such great variation that it will be a matter of great difficulty properly to express, in terms of species, the several hybrids which result from the crossing of the numerous potent forms of *V. fimbriatula*, and *V. sagittata*, with other and more constant species. My own observations upon the violets of this region convince me that such species as *V. fimbriatula*, *V. sagittata*, *V. palmata*, *V. cucullata*, *V. emarginata*, and *V. Brittoniana*, do produce seeds from the petaliferous flowers, which are capable of germination and growth, and much as I was loath to admit the fact, I was convinced that not only a few, but that numerous hybrids exist between these species and others.

VIOLA SAGITTATA Ait. Hort. Kew. **3**: 287. 1789.

In its typical form (*nos. 60 and 61*) this species is nearly or

* Proc. Acad. Phila. **1903**: 683. *pl. 37. f. 4, 6.* 1903.

† Rhodora **6**: 218. 1904.

‡ Bull. Torrey Club **24**: 404. 1897.

quite glabrous, but forms occur, and usually more abundantly, which are more or less ciliate or even pubescent and it is often difficult to determine whether the specimens under consideration should be referred to *V. sagittata*, to *V. fimbriatula*, or to some hybrid form.

The key to the species and varieties of violets of New Jersey given below contains 33 species and varieties, of which 29 occur in Middlesex County, and are indicated by a star. Further report of the hybrid forms will be made by President Ezra Brainerd of Middlebury College, to whom they have been referred.

KEY TO THE SPECIES OF NEW JERSEY VIOLETS.

I. Acaulescent; flowers scapose.

A. Plants stoloniferous.
- Corolla purple; introduced, fragrant species. — *1. *V. odorata.*
- Corolla white or yellow.
  - Corolla yellow; leaves orbicular. — 2. *V. rotundifolia.*
  - Corolla white.
    - Cleistogenes deflexed; leaf-blades from broadly ovate to orbicular.
      - Upper and lateral petals twice as long as broad; petioles not spotted. — *3. *V. blanda.*
      - Upper and lateral petals thrice as long as broad; petioles red-spotted. — *4. *V. LeConteana.*
    - Cleistogenes erect; leaf-blades from narrowly oval to linear.
      - Leaf-blades from lanceolate to linear-lanceolate. — *5. *V. lanceolata.*
      - Leaf-blades oval or ovate-oblong. — *6. *V. primulaefolia.*

B. Plants not stoloniferous.
- Cleistogamous flowers wanting; petals beardless; leaves divided.
  - Upper petals purple, lower blue. — 7. *V. pedata.*
  - Upper and lower petals of the same color. — *8. *V. pedata lineariloba.*
- Cleistogenes usually present; lateral and often the lower petals bearded.
  - Cleistogamous flowers deflexed, horizontal or on short spreading peduncles.
    - Plant glabrous or nearly so.
      - Leaf-blades attenuate; petioles glabrous; petals light-blue.
        - Leaf-blades but little longer than broad. — *9. *V. affinis.*

Leaf-blades twice as long as broad, deeply cordate. *10. *V. nepetaefolia*

Leaf-blades acute, deeply cordate; petioles pubescent; petals deep purple-blue, the upper ones reflexed. *11. *V. papilionacea.*

Plant pubescent or hirsute.

Leaves entire.

Plant less than 1 dm. high; leaves spreading, hirsute above, glabrous beneath. *12. *V. villosa.*

Plant more than 1 dm. high; leaves erect, softly pubescent throughout. *14. *V. palmata variabilis.*

Leaves lobed.

Lobes extending about to center of the blade, or blades deeply 3-lobed. *13. *V. palmata.*

Lobes extending nearly or quite to the base of the blade, lobes more than 3.

Corolla deep purple-blue, early leaves entire. *14. *V. palmata variabilis*

Corolla light-blue; early leaves lobed. *15. *V. palmata Angellae.*

Cleistogenes erect or ascending on long peduncles.

Leaves lobed or divided.

Sepals with short blunt auricles at base; leaves ciliate; cleistogenes on peduncles 5–6 cm. long. *16. *V. Stoneana.*

Sepals long-auricled at base; plants glabrous; cleistogenes on peduncles 10–15 cm. long.

Lobes extending nearly to base of blade, the 5–9 lobes linear-lanceolate, the middle lobe 3-divided. *17. *V. Brittoniana.*

Lobes irregular, extending to or somewhat beyond the middle of blade. *18. *V. Brittoniana* × *cucullata.*

Leaves entire; crenate or dentate, or incised at the base, not deeply lobed.

Leaf-blades cordate-ovate or cordate-oblong in outline.

Plant glabrous; leaf-blades cucullate, broadly ovate-cordate, sinuate-dentate. *19. *V. cucullata.*

Leaf-blades pubescent; crenate-dentate.

Leaf-blades oblong-ovate, blunt, shallowly cordate. *20. *V. conjugens.*

Leaf-blades ovate, deeply cordate, acute. *22. *V. fimbriatula aberrans.*

Leaf-blades not cordate-ovate or cordate-oblong in outline.

Leaf-blades ovate-sagittate or oblong-lanceolate and sagittate.

Plant densely pubescent or villous; petioles usually shorter than the blades. *21. *V. fimbriatula.*

Plant glabrous or ciliate; petioles usually longer than the blades. *23. *V. sagittata.*

Leaf-blades triangular in outline, dentate or incised at the base.

Plant sparingly pubescent; leaf-blades longer than broad, usually dentate at base. *24. *V. Porteriana.*

Plant glabrous; leaf-blades mostly broader than long.

Auricles of the sepals very long; blades dentate or incised at the base. *25. *V. emarginata.*

Auricles of the sepals short and blunt; leaf-blades conspicuously pectinate. *26. *V. pectinata.*

II. Caulescent; leafy-stemmed.

A. Corolla yellow; leaf-blades ovate-reniform, entire.

Plant pubescent; root-leaves usually wanting. *27. *V. pubescens.*

Plant glabrate; root-leaves usually present. *28. *V. scabriuscula.*

B. Corolla purple, white or cream-colored.

Stipules entire; petals white or tinged with purple. 29. *V. canadensis.*

Stipules incised or pinnatifid.

Perennial; stipules much smaller than the leaf-blades.

Petals cream-colored, the lower ones purple-veined. 30. *V. striata.*

Petals blue or purple, rarely white.
Spur shorter than the petals. *31. *V. labradorica.*
Spur longer than the petals. *32. *V. rostrata.*
Annual; stipules nearly as large as the blades. *33. *V. Rafinesquii.*

Sets of the violets collected in Middlesex County have been placed in the herbaria of the New York Botanical Garden and the National Museum, and in the private herbaria of Mr. Witmer Stone and President Ezra Brainerd. The first, and therefore most complete set, is retained in the writer's own herbarium.

UNITED STATES NATIONAL MUSEUM.

Explanation of plates 16–18

PLATE 16

Viola Stoneana House, natural size. *A*, flower capsule. *B*, cleistogamous capsule.

PLATE 17

Viola Brittoniana × *cucullata* House, natural size. *A*, cleistogamous flower. *B*, cleistogamous capsule.

PLATE 18

Viola pectinata Bicknell, natural size.

Bryological Notes — II

Elizabeth Gertrude Britton

Some changes in generic names

Some recent studies of Dr. Small's subtropical Florida collections and of the mosses gathered by me in the Bahamas on two recent expeditions, as well as those from Jamaica collected by Mr. Harris, Mr. Maxon, and Professor Underwood, make it desirable to record some of the discoveries which I have made in trying to place some of the most puzzling species.

The following species was announced as a new species of *Cryphaea* at the Philadelphia meeting of the Sullivant Moss Chapter in December, and drawings were shown of it. I have since found that it is a common West Indian species which does not belong to any of the genera to which it has been referred, so I propose a new generic name, **Pseudocryphaea,** to include the one and only species known to me:

Pseudocryphaea flagellifera (Brid.)

? *Hypnum nudicaule* Schwaegr. Suppl. **1**^{2}: 223. 1816.
? *Pterigynandrum nudicaule* Brid. Bryol. Univ. **2**: 182. 1827.
Pilotrichum flagelliferum Brid. Bryol. Univ. **2**: 259. 1827.
Neckera domingensis C. Müll. Syn. Musc. **2**: 95. 1850.
Cryphaea? leptoclada Sull. Proc. Am. Acad. **5**: 283. 1861.— Paris, Index 289.
Leucodon domingense Mitt. Jour. Linn. Soc. **12**: 409. 1869.— Paris, Index 755.

From the number of different genera in which it has been placed it is evident at first sight that there is something wrong with this species. It is not a *Leucodon*, as the leaves are costate; it is not a *Pilotrichella*, though it resembles *P. cymbifolia* in the slightly papillose leaves, formed by the projecting ends of the cells; the cells of the leaves resemble more closely those of *Leptodon trichomitrion*, but the plants differ in their striking method of branching and forming slender flagella; the specific names given to it by various authors show this to be the most marked characteristic of the species. The same habit is described by Correns in *Leucodon sciuroides.* He states that it is dioicous and seldom fruits and is propagated by brittle branchlets, a habit of tree-growing species. The young stems are unbranched and simple, but later they have short, small-leaved lateral branches which are brittle and fugacious!

The fruit has not been carefully described. This is a translation of what Müller says of it:

> "Perichaetium long-exserted, very narrow, pale; leaves long lanceolate-acuminate, convolute, long-reticulate; capsule on a long slender yellow pedicel, erect, ovate, brownish.
>
> "Very common throughout the Antilles and the neighboring borders of Venezuela, but very rarely fertile, first collected by Bertero in San Domingo.
>
> "A very beautiful and very distinct species. Fruit of *N. longiseta.*"

We have this species from five stations near Miami, Florida, where it has been collected by *Garber* and by *Small;* also at Lake Harris, *J. D. Smith,* 1879. It was distributed from Cuba, *Chas. Wright 68;* Porto Rico, *Sintenis 53, Heller 578* and *820, O. F. Cook 1031;* Jamaica, *Underwood 2981* and *2015*, and *Maxon 843*. Also from Mexico, near Cordova, *C. Mohr,* 1857 and *Pringle 2146.*

In searching through the literature to see whether this species had previously been recorded from the United States, I found in Kindberg's *European and North American Bryinæ* that he includes *Alsia abietina* under *Leptodon* with *L. Smithii,* the type of the genus; that he separates *Leptodon trichomitrion* under *Forsstroemia* Lindberg, including five North American species; that he places under *Alsia, A. longipes* and *A. circinnata* (Brid.); and transfers *Alsia californica*, the type species of this genus, to *Antitrichia* and rechristens it *Antitrichia pseudo-californica,* because there was already an *Antitrichia californica* Sull. He transfers this last species to a new genus and calls it *Macouniella californica* Kindb. There are five distinct propositions here which will be taken up separately.

There is no question that *Leptodon Smithii* resembles *Alsia abietina* Sull. in its circinate habit, but it is a very superficial resemblance, which the leaf-characters at once dispel! There is a much greater resemblance to *Pterobryum densum* Hsch. in the shape, serration and venation of the leaves; but the prominent spinose teeth on the back are peculiar in *A. abietina*, and resemble those of *Pterogonium gracile*, though the size and habit of the plants is quite distinct, as well as the leaf-characters.

Most bryologists will admit that *Leptodon Smithii* and *L. trichomitrion* are not congeneric and accept *Forsstroemia* Lindb. for the latter and its allied species; but Paris' *Index*, although accepting both genera, limits *Forsstroemia* to *F. trichomitrion* (Hedw.) Lindb. and some other exotic species, and leaves most of our North American species in *Leptodon* with *L. Smithii.* Kindberg is more nearly correct in the list of species he includes, but *Cryphaea Ravenelii* belongs where Austin placed it!

Jaeger in the *Adumbratio* listed three of our species under *Lasia* Beauv. 1805 (*non* Bridel) but this generic name is antedated by *Lasia* Loureiro, 1790, and that is why Lindberg substituted *Forsstroemia* in 1862. Sullivant made an anagram of *Lasia* when he described *Alsia* because of the resemblance between *Lasia trichomitrion* (Hedw.) Beauv. and *Alsia californica* Sull. This is the type species of *Alsia* and its synonymy is as follows:

ALSIA CALIFORNICA (Hook. & Arn.) Sull. Proc. Am. Acad. Arts & Sci. **3**: 185. 1857; Musc. Wilkes Exp. 25. *pl. 25.* 1859.

Neckera californica Hook. & Arnott, Bot. Beechey Exp. 162. 1833.

Antitrichia pseudo-californica Kindb. Eu. and N. A. Bryin. 9. 1897.

It started as a monotypic genus, and it was not till 1864, in the *Icones*, that Sullivant enlarged the genus to include *Neckera abietina* Hooker. This was undoubtedly a mistake which Kindberg has detected, but failed to rectify in the correct way. I therefore propose the following new name:

Dendroalsia

Type species: **Dendroalsia abietina** (Hook.)

Neckera abietina Hook. Musc. Exotici *pl. 7.* 1818.

Pilotrichum abietinum Brid. Bryol. Univ. **2**: 258. 1827.

Type locality: N. W. Coast of North America. *Menzies*, 1792.

Type in herbarium of Hooker.

These plants were figured 6 inches high, with stems naked at base for 2–3 inches, simply pinnate or bipinnately compound (often with flagelliferous branches 2–3 inches long) leaves long-acuminate. The cells are dorsally papillose to base, papillae are larger at apex, spinose especially on the end of the vein, seta not entirely immersed, capsule cylindric, 3 mm. long; peristome pale, papillose and densely nodose: endostome slightly perforate, also pale and papillose.

Hooker says that the peristome is red and the endostome pale-yellow, but Schwaegrichen, *pl. 140*, in a colored plate, figures the peristome as a light yellowish-green.

Apparently this is a very rare species and it is doubtful if Sullivant saw typical specimens!

It is also to be remembered that Sullivant included among the synonyms of *Alsia abietina* his *Leptodon circinalis.* Again it seems clear that Sullivant made a mistake in supposing that Hooker's specimens were the same as his and in stating that Hooker's specimens were not typical and that the smaller circinate plants were the antheridial plants of the larger. He says: "The specimens collected by Menzies, and figured by Hooker and Schwaegrichen (*l.c.*), are unusually elongated and distinctly pinnate, owing doubtless to local influences, and therefore do not represent the normal form of the species, as here figured from numerous specimens furnished by other collectors." A comparison of Sullivant's figures with those cited above will show the macroscopic as well as the microscopic differences between these two species. Specimens of *Dendroalsia abietina* have been sent to me by J. B. Leiberg from granite ledges near Lake Pend d'Oreille, Idaho, which measure 8–10 inches in length, are doubly pinnate and have long slender flagellate branches. They are also much less circinate and show other differences from the smaller species, as the following synopsis and description will indicate:

Plants 4–10 inches high. Leaves papillose to base. *D. abietina.*
Plants 2–4 inches high. Leaves papillose only at apex. *D. circinalis.*

Dendroalsia circinalis (Sull.)

Leptodon circinalis Sull. Bot. Pac. R.R. Survey. 4: 189. *pl. 1.* 1856.

Alsia abietina Sull. (in part) Icon. Musc. 115. *pl. 72b.* 1864.

Alsia Macounii Kindb. Bull. Torrey Club **17**: 275. 1890.

Plants seldom more than 3–4 inches high, more circinate when dry than *D. abietina:* leaves shorter, 1 mm., and broader, 0.5 mm., ovate-lanceolate, less serrate and acuminate at apex, papillose only above the middle, papillae smaller and more numerous; base broader with strongly revolute margins, vein stouter and less spinosely toothed at apex: capsules shorter and broader, with a shorter seta more completely immersed in the broader and less pointed, perichaetial leaves; peristome longer and more slender, less papillose; endostome perforate; spores larger and rougher.

According to Kindberg, the only American species of *Alsia* is *A. longipes* Sull. & Lesq., with which he associates a European species of *Eurhynchium*, *E. circinnatum* (Brid.) Br. & Sch. This is another case of incomprehensible confusion, for apparently, there is no resemblance, either superficial or real between these two species.

Alsia longipes has the leaf-characters of *Dendroalsia*, but differs in its sporophyte in several ways, having a long-exserted seta, a cylindric capsule and an endostome with appendiculate cilia. Still there seems no necessity for separating it from the other allied species, so the following name is proposed:

Dendroalsia longipes (Sull. & Lesq.).

Alsia longipes Sull. & Lesq. Musc. Bor.-Am. Ed. 2. *No. 399.* 1865. Sull. Icon. Musc. Supp. 85. *pl. 63.* 1874.

Type station: On shaded rocks in deep canyons, Oakland, California, *Bolander.* This species must be rare, as it is recorded from only two other stations in California, *viz.*, near Berkeley, *M. A. Howe*, and southern California, *McClatchie*, and one in Alaska.

Macouniella Kindberg.

It is with much regret that I am forced to believe that the genus *Macouniella* Kindb. will not stand. As has already been stated, the genus was founded on *Antitrichia californica* Sull. and some specimens from France were referred to it. The type species of *Antitrichia* is *A. curtipendula.* Limpricht in the Laubmoose maintains in the same genus *A. californica* Sull. to which *A. curtipendula* var. *hispanica* Sch. including specimens from Algiers, Spain and Italy, had been referred by Schimper himself. He gives a short and excellent key to separate them, which is translated as follows:

Leaves plicate, with accessory veins. *A. curtipendula.*
Leaves not plicate, with only one vein. *A. californica.*

A careful comparison of European specimens, descriptions and illustrations has convinced me that all five of the differences claimed by Kindberg to separate var. *gigantea* as a species, are variable and unreliable. A large series of European specimens in the Jaeger Herbarium shows this and the description given by Limpricht in the *Laubmoose* indicates a variable species. He states that the stems may be simple or branched, the branches thick at the apex or slender, often flagellate; the leaves mostly serrate, with 1–2 accessory veins on each side of the midvein; and the seta straight or curved. He recognizes two varietal names in a foot-note but evidently considers them of little importance.

Antitrichia tenella Kindb. and var. *flagellifera* R. & C. seem referable to *A. curtipendula* and are probably one and the same thing.

The American species of Erpodium

In both editions of Paris' Index Bryologicus this genus is credited to Bridel, yet he used it only as a *subgenus* of *Anoectangium* and Carl Müller (Bot. Zeit. **1**: 774. 1843) was the first to use it as a generic name. Of the 20 species recognized, 9 are credited to America, 3 are from Paraguay, 2 from Argentina, 2 from Brazil, 1 from Mexico and 1 from the West Indies. Of these *Erpodium domingense* is reported as having been collected in Cuba, Jamaica and Porto Rico, but the type station Sto. Domingo is omitted from the second edition, though it is the only one cited in the first! Recent collections from Jamaica by Professor Underwood include one specimen of this rare and interesting genus, which I have referred to *Erpodium domingense* from the descriptions only, not having any specimens for comparison! *Erpodium domingense* is the type species.

ERPODIUM DOMINGENSE (Brid.) C. Müll. Bot. Zeit. **1**: 773. 1843.
Anoectangium Erpodium domingense Brid. Bryol. Univ. **2**: 167. 1827.

Anoectangium? domingense Schwaegr. Suppl. *pl. 267.* 1829–30.
Pilotrichum domingense C. Müll. Syn. Musc. **2**: 184. 1851.

Type locality: Sto. Domingo. Coll. *Balbisius.* On trees.

Plants closely appressed, light-green or brown; stems creeping and rooting, branches short and irregular. Leaves imbricated and appressed, overlapping half their length, ecostate, entire but the margins crenulate with papillae; apex rounded; cells large, 0.013 x 0.018 mm., all thick and obscure; basal cells longer and smooth: autoicous: antheridia few, in a small axillary bud without paraphyses: archegonia terminating short lateral branches; perichaetial leaves with acute spreading points: seta short, nearly or quite immersed: capsules erect, 1 mm. long, cylindric, pale-yellow, contracted below the mouth when dry, walls parenchymatic, thin at base; neck stomatose; peristomes none, lid conic, apiculate; calyptra not seen; spores green, smooth, 0.027–0.032 mm.

On trees in Sto. Domingo, Porto Rico and Hope Mines near Kingston, Jamaica, *L. M. Underwood 4*, 24 January, 1903.

Remarkable for its resemblance to the *Hepaticae*, especially certain species of *Frullania* for which it has been mistaken and hence probably has seldom been collected.

Erpodium cubense E. G. Britton, n. sp.

Erpodium domingense fide Paris Index ed. 2. 156?

Only a few scraps selected from Charles Wright's Cuban Hepaticae by C. F. Austin have been seen, so the general aspect of this species is unknown, but the leafy stems are similar to those of *Erpodium domingense* and might easily be mistaken for them. The leaves, however, are smaller and more blunt at apex; the marginal apical cells are rectangular and smaller, only 0.005–0.008 mm. and obscure, with small dense papillae; the cells are rhomboidal in the upper part of the perichaetial leaves and 0.008 x 0.013 mm.; the capsule is sessile and quite immersed, only 0.5 mm. long, "with a fragmentary peristome" *fide* Austin; the calyptra 0.25 mm. with lobed base; spores 0.013 mm. Found by Austin with *Lejeunea, no. 201g* of Wright's Cuban Hepaticae. Type from the Herbarium of C. F. Austin.

Type locality?

This species differs from *E. domingense* in having leaf-cells one-half the size and more dense and obscure, and in its smaller and immersed capsule.

These specimens were in the herbarium of P. V. LeRoy for many years and have been purchased by the New York Botanical Garden.

ERPODIUM BISERIATUM (Austin) Austin, Bot. Gaz. **2**: 142. 1877. *Lejeunea biseriata* Austin, Proc. Acad. Sci. Phila. **21**: 225. 1869.

Stems slender, 1 cm. long and (with leaves) about 1 mm. wide. Leaves 0.40–0.50 mm. long, unequal at base, cells at apex distinct, hexagonal or rounded, 0.003 × 0.013 mm. in diameter with thick brown walls, basal and central cells longer and narrower, 0.010 × 0.040 mm., the translucent marginal cells not papillose, dorsal cells with from 4–8 minute papillae. Fruit unknown.

Collected with *Lejeunea Sullivantii* by *W. S. Sullivant* near Augusta, Georgia, in 1845.

These specimens and a full series of notes were sent to Manchester, England, with Austin's hepatics and remained there a number of years in the herbarium of W. H. Pearson. They were subsequently returned and placed among the *Hepaticae* in the Columbia University Herbarium where they were found by Dr. M. A. Howe.

Erpodium Pringlei E. G. Britton, n. sp.

Plants in thin, appressed, glaucous-green mats: stems creeping and branching, branches short: leaves densely imbricate, squarrose with spreading points, ovate, 0.5 mm. long, apex acute or obtuse, papillose or hyaline, the cells hexagonal, papillose, large, 0.013 × 0.021 mm. in diameter, with brown walls thickened at angles, collenchymatic; margins entire or minutely papillose-crenulate, basal cells elongated and smooth; perichaetial leaves scarious, erect-clasping, apiculate, with clear apical cells; capsule half-immersed, 1 mm. long, lid apiculate, mouth bordered by red cells as well as the lid; peristome none: spores rough, 0.027–0.035 mm.

Type station: Mexico, near Guadalajara, *C. G. Pringle*, 1889, *no. 710*, on trees; Zapotlen, May 28, 1893, and Terzuela, July 2d, 1893, *no. 16a*.

This genus is not recorded for Mexico by Bescherelle in his *Prodromus Bryologiae Mexicanae*. Dr. Max Fleischer states that *E. diversifolium* C. Müll. appears to be only *E. domingense!*

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Bailey, L. H. Systematic work and evolution. Science II. **21**: 532–535. 7 Ap 1905.

Britton, N. L. Manual of the flora of the Northern States and Canada. Edition 2. i–xxiv. 1–1112. New York, 1905.

Claassen, E. Key to the liverworts recognized in the sixth edition of Gray's Manual of botany. Ohio Nat. **5**: 312–315. 24 Ap 1905.
Key to the genera only.

Cockerell, T. D. A. The name *Melampodium*. Torreya **5**: 70. 27 Ap 1905.

Coker, W. C. Vegetation of the Bahama Islands. 185–270. *pl. 1* and *pl. 33–47*. New York, 1905.
Special Publ. from "The Bahama Islands" (Geogr. Soc. Baltimore). In the list of plants collected, several are described as new.

Cotton, E. C. Key to Ohio ashes in the winter condition. Ohio Nat. **5**: 270. 24 Ja 1905.

Cushman, J. A. Notes on the zygospores of certain New England desmids, with descriptions of a few new forms. Bull. Torrey Club **32**: 223–229. *pl. 7, 8*. 6 My 1905.
With descriptions of 2 new species and several new varieties.

Davidson, A. Flora of Clifton, Arizona. II. Bull. So. Calif. Acad. Sci. **4**: 18, 19. 21 F 1905; — III. Bull. So. Calif. Acad. Sci. **4**: 35, 36. 30 Mr 1905.

Davis, B. M. Studies on the plant cell — V. Am. Nat. **39**: 217–268. *f. 16–18.* 26 Ap 1905.

Eastwood, A. New species of western plants. Bull. Torrey Club **32**: 193–218. 6 My 1905.
Descriptions of 38 new species in 26 genera.

Evans, A. W. New or noteworthy *Hepaticae* from Florida. Bull. Torrey Club **32**: 179–192. *pl. 5.* 6 My 1905.
Including new species in *Plagiochila*, *Cololejeunea*, and *Lejeunea*.

Flory, C. H. Key to the Ohio maples in the winter condition. Ohio Nat. **5**: 297, 298. 23 Mr 1905.

Gleason, H. A. Notes from the Ohio State Herbarium. II. Ohio Nat. **5**: 264. 24 Ja 1905; — III. Ohio Nat. **5**: 316–319. 24 Ap 1905.

Greene, E. L. Diagnoses *Aragallorum.* Proc. Biol. Soc. Wash. **18**: 11–17. 20 Ja 1905.
Descriptions of 19 new species.

Greene, E. L. Some West American red cherries. Proc. Biol. Soc. Wash. **18**: 55–60. 21 F 1905.
Descriptions of 10 new species in *Cerasus.*

Harper, R. M. Some noteworthy stations for *Pinus palustris.* Torreya **5**: 55–60. 27 Ap 1905.

Hollick, A. The occurrence and origin of amber in the eastern United States. Am. Nat. **39**: 137–145. *pl. 1–3.* 8 Ap 1905.

Howe, M. A. Some of the coralline seaweeds in the museum. Jour. N. Y. Bot. Gard. **6**: 59–64. *pl. 24, 25.* Ap 1905.

Kellerman, W. A. Elementary mycology. Jour. Myc. **11**: 34–38. 4 Ja 1905.

Kellerman, W. A. Ohio fungi. Fascicle X. Jour. Myc. **11**: 38–45. 4 Ja 1905.

Kellerman, W. A. Uredineous infection experiments in 1904. Jour. Myc. **11**: 26–33. 4 Ja 1905.

King, C. A. Experiment to show that the absence of light alone will prevent the process of photosynthesis. Torreya **5**: 67, 68. 27 Ap 1905. [Illust.]

Lloyd, C. G. The *Lycoperdaceæ* of Australia, New Zealand, and neighboring islands. 1–44. *pl. 25–39 + f. 1–49.* Cincinnati, Ohio, Ap 1905.

Longyear, B. O. An undescribed *Alternaria* affecting the apple. Science II. **21**: 708. 5 My 1905.

MacDougal, D. T. Discontinuous variation and the origin of species. Science II. **21**: 540–543. 7 Ap 1905.

Maxon, W. R. A new *Botrychium* from Jamaica. Bull. Torrey Club **32**: 219–222. *pl. 6.* 6 My 1905.
B. Underwoodianum sp. nov.

Memminger, E. R. *Agaricus amygdalinus* M. A. C. Jour. Myc. **11**: 12–17. 4 Ja 1905.

Morgan, A. P. *Sphaeria calva* Tode. Jour. Myc. **11**: 1. 4 Ja 1905.

Murrill, W. A. Terms applied to the surface and surface appendages of fungi. Torreya **5**: 60–66. 27 Ap 1905.

Nash, G. V. The crested orchid [*Coelogyne cristata*]. Jour. N. Y. Bot. Gard. **6**: 64, 65. *pl. 26.* Ap 1905.

Parish, S. B. Birds and mistletoe: a correction. Torreya **5**: 68, 69. 27 Ap 1905.

Parish, S. B. A preliminary synopsis of the Southern California *Cyperaceae* — VI. Bull. So. Calif. Acad. Sci. **4**: 8–13. *pl. 9, 10.* 21 F 1905; — VII. Bull. So. Calif. Acad. Sci. **4**: 51, 52. 1 My 1905.
With description and illustration of *Scirpus pacificus* Britton, sp. nov.

Penhallow, D. P. The anatomical changes in the structure of the vascular cylinder incident to the hybridization of *Catalpa.* Am. Nat. **39**: 113–136. *f. 1–8.* 8 Ap 1905.

Perkins, J. Fragmenta floræ philippinæ: contributions to the flora of the Philippine Islands. **1**: 153–212. *pl. 4.* Leipzig, 20 F 1905.
This fascicle is devoted wholly to the description of novelties.

Pinchot, G. A primer of forestry. Part II. — Practical forestry. U. S. Dept. Agr. Forestry Bull. **24**[2]: 1–88. *pl. 1–18 + f. 1–47.* 1905.

Riddle, L. C. Brush Lake algae. Ohio Nat. **5**: 268, 269. 24 Ja 1905.

Riddle, L. C. Development of the embryo-sac and embryo of *Staphylea trifoliata.* Ohio Nat. **5**: 320–325. *f. 1–27.* 24 Ap 1905.

Riddle, L. C. Notes on the morphology of *Philotria.* Ohio Nat. **5**: 304, 305. 23 Mr 1905.

Rose, J. N. Studies of Mexican and Central American plants — No. 4. Contrib. U. S. Nat. Herb. **8**: i–ix. 281–339. *pl. 63–72 + f. 14–19.* 20 Ap 1905.
Includes descriptions of 2 new genera and many new species of flowering plants.

Sargent, C. S. Manual of the trees of North America (exclusive of Mexico). i–xxiii. 1–826. *map + f. 1–642.* Boston, [Mr] 1905.

Schaffner, J. H. The classification of plants, I. Ohio Nat. **5**: 298–301. 23 Mr 1905.

Schaffner, J. H. Key to the genera of Ohio woody plants in the winter condition. Ohio Nat. **5**: 277–286. 24 F 1905.

Schaffner, J. H. Key to Ohio poplars in the winter condition. Ohio Nat. **5**: 271. 24 Ja 1905.

Schaffner, J. H. Key to Ohio walnuts based on twig characters. Ohio Nat. **5**: 307. 23 Mr 1905.

Schaffner, J. H. The life cycle of a heterosporous pteridophyte. Ohio Nat. **5**: 255–260. *f. 1.* 24 Ja 1905.

Schaffner, J. H. *Lycopodium porophilum* in Ohio. Ohio Nat. **5**: 301. 23 Mr 1905.

Schaffner, J. H. Mat plants. Ohio Nat. **5**: 265, 266. 24 Ja 1905.

Schaffner, J. H. Plants with nodding tips. Ohio Nat. **5**: 267. *f. 1.* 24 Ja 1905.

Schaffner, J. H. The struggle for life on a certain sandbar. Ohio Nat. **5**: 302, 303. *f. 1.* 23 Mr 1905.

Schaffner, M. Key to the Ohio sumacs in the winter condition. Ohio Nat. **5**: 293. 24 F 1905.

Scholl, L. H. Key to the Ohio hickories in the winter condition. Ohio Nat. **5**: 269. 24 Ja 1905.

Seaver, F. J. A new species of *Sphaerosoma*. Jour. Myc. 11: 2–5. *pl.* 4 Ja 1905.

S. echinulatum sp. nov., from Iowa.

Smith, L. M. Key to the Ohio elms in the winter condition. Ohio Nat. **5**: 316. 24 Ap 1905.

Tillman, O. I. Ohio plants with tendrils. Ohio Nat. **5**: 305–307. 23 Mr 1905.

Wacker, A. H. Ecological notes on Ohio pteridophytes. Ohio Nat. **5**: 295–297. 23 Mr 1905.

Winslow, C.-E. A. & Rogers, A. F. A revision of the *Coccaceae*. Science II. **21**: 669–672. 28 Ap 1905.

York, H. H. The hibernacula of Ohio water plants. Ohio Nat. **5**: 291–293. *f. 1–3.* 23 Mr 1905.

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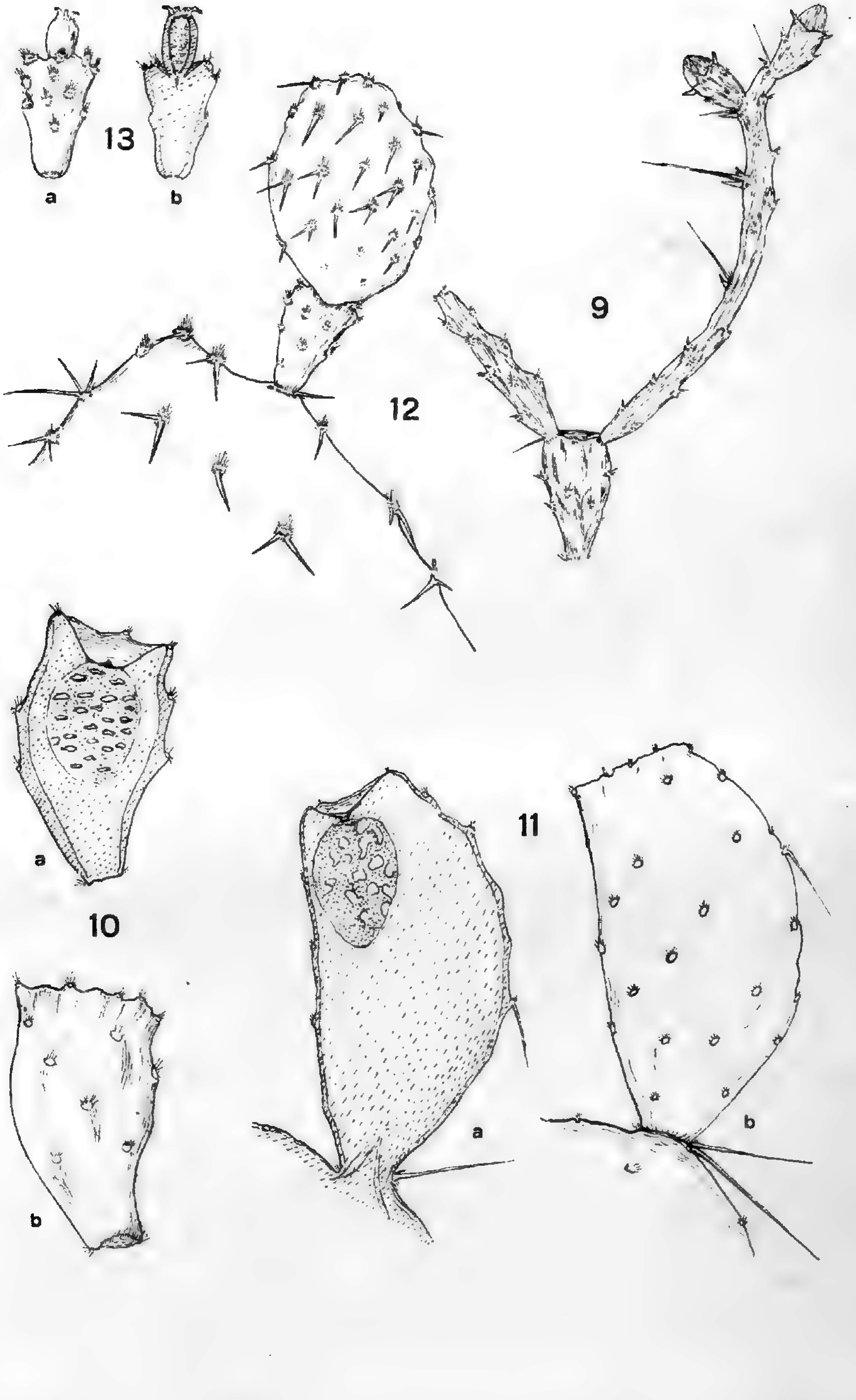

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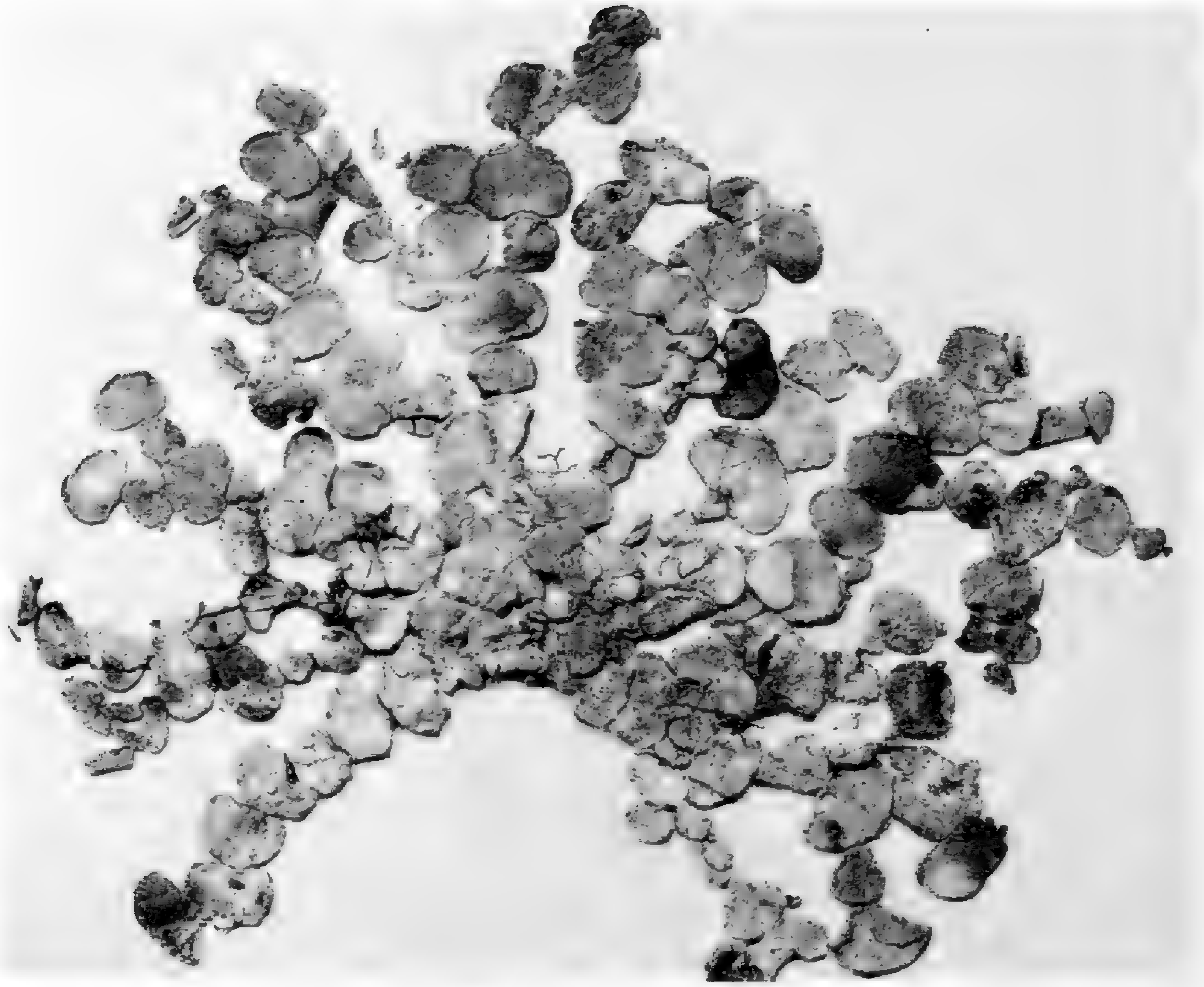

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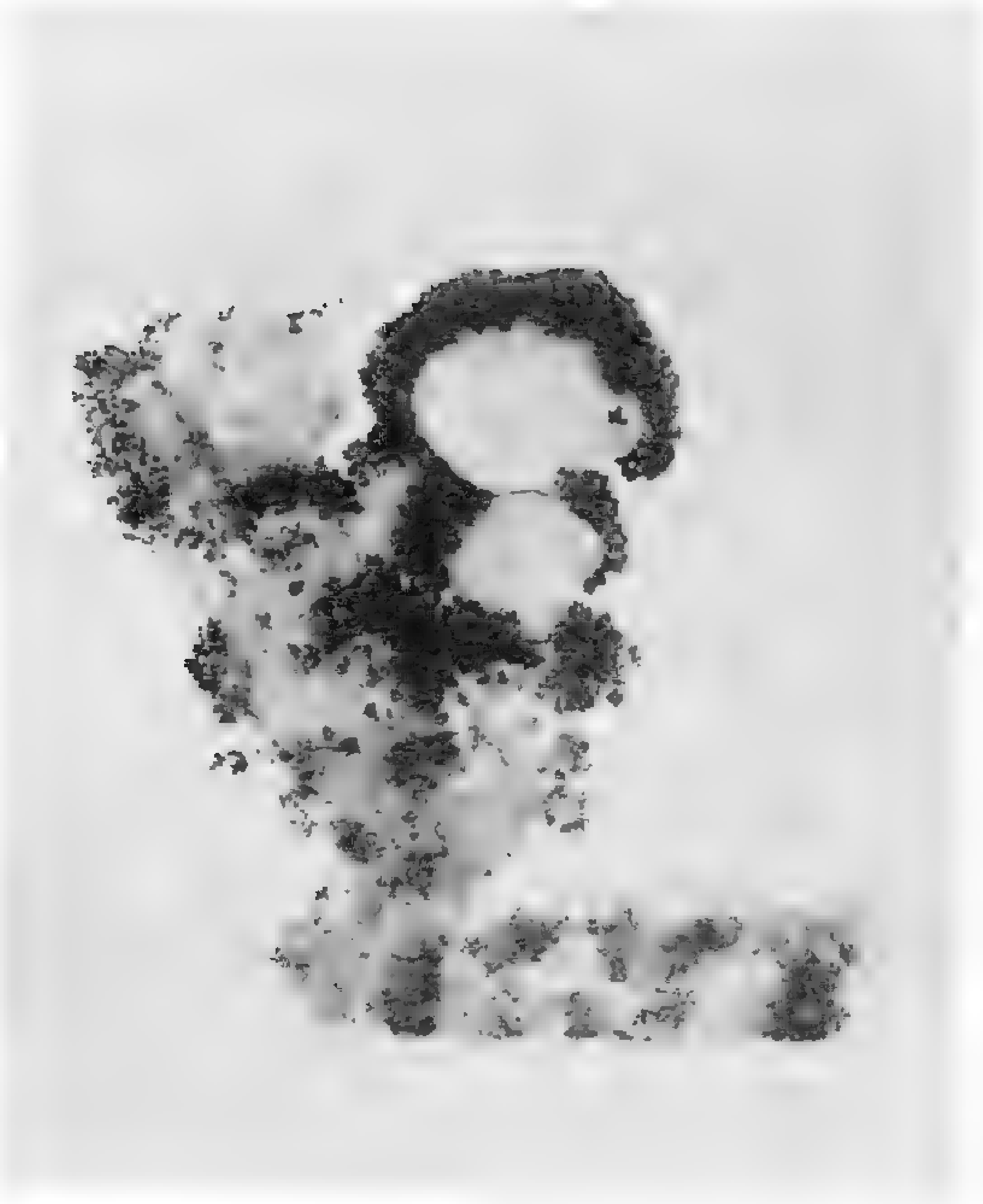

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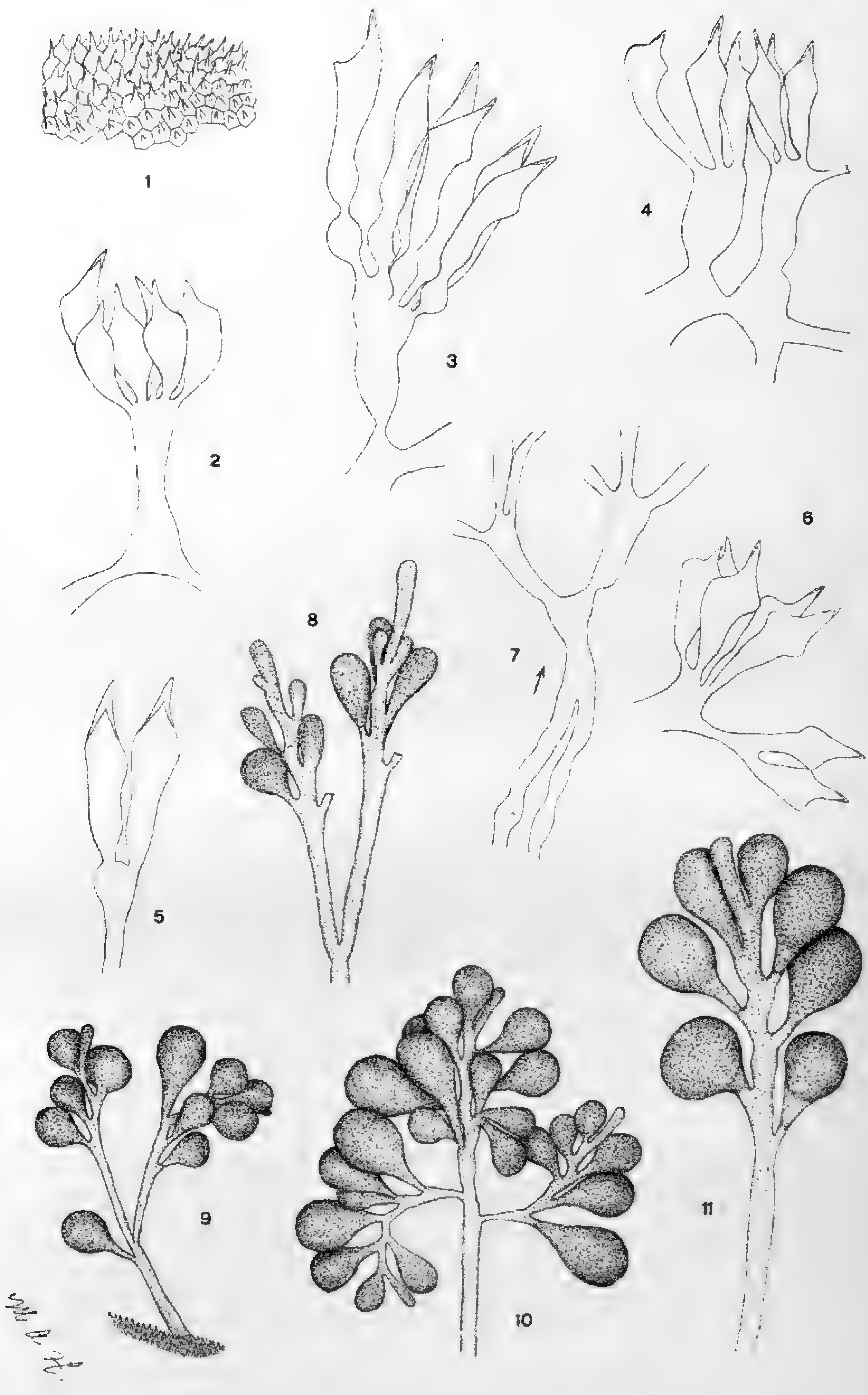

HALIMEDA SCABRA M. A. Howe.

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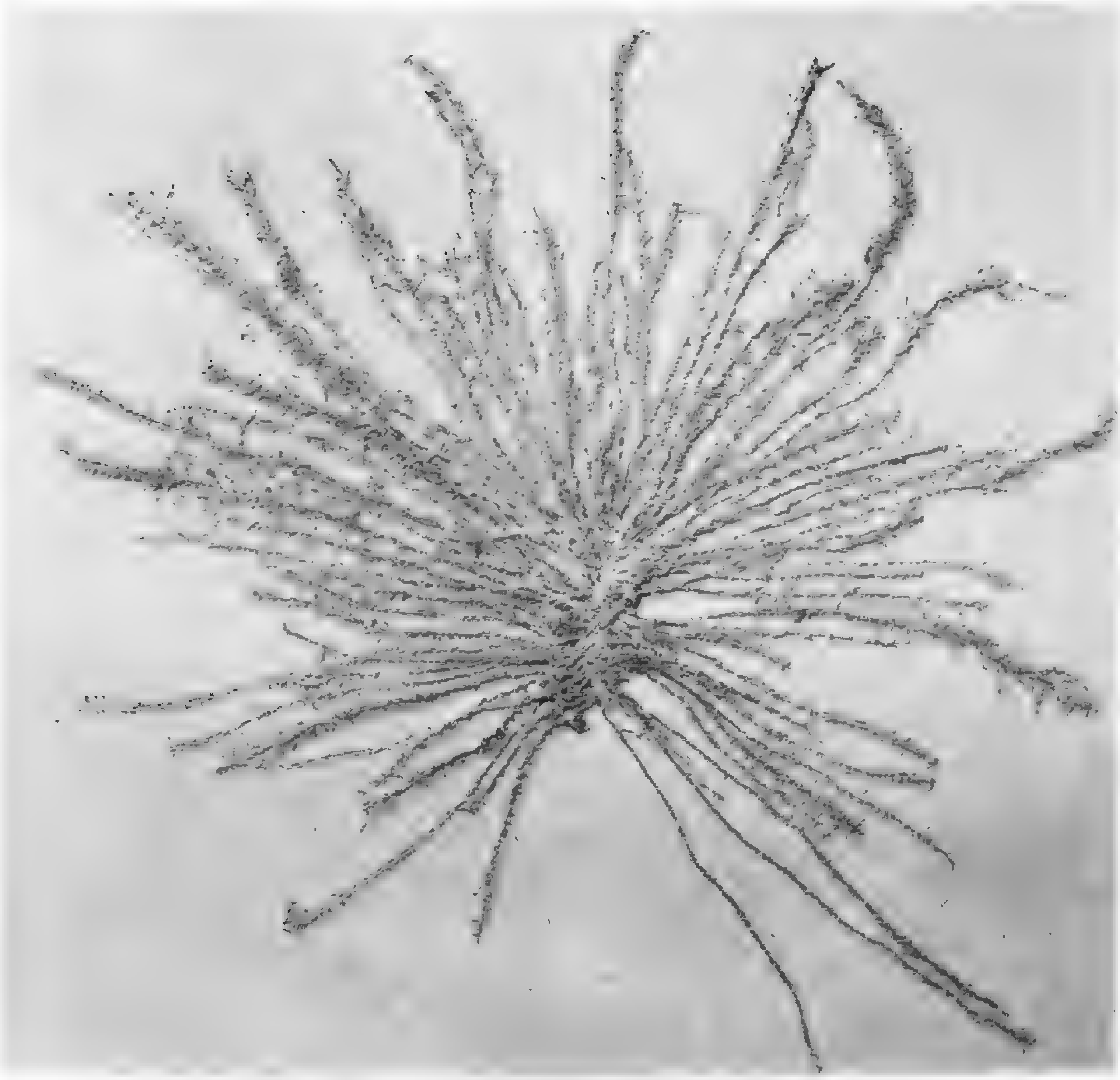

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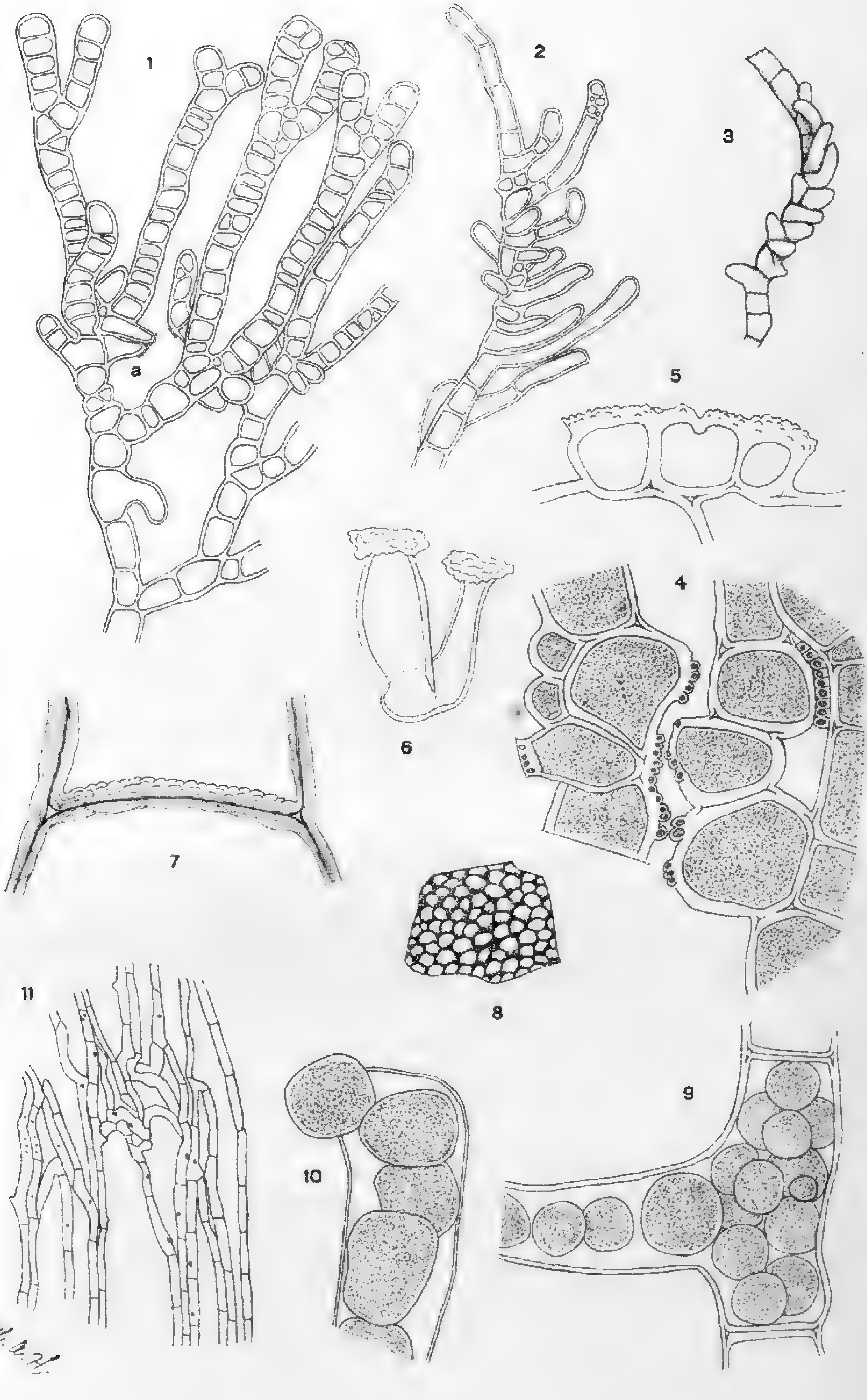
1. SIPHONOCLADUS RIGIDUS M. A. Howe
2. SIPHONOCLADUS TROPICUS (Crouan) J. Ag.



SIPHONOCLADUS RIGIDUS M. A. Howe.

PETROSIPHON ADHAERENS M. A. Howe

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VIOLA BRITTONIANA × CUCULLATA House

VIOLA PECTINATA Bicknell

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The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

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CONTENTS

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BULLETIN

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TORREY BOTANICAL CLUB

JUNE, 1905

Hepaticae of Puerto Rico

V. CERATOLEJEUNEA

Alexander W. Evans

(With plates 19 and 20)

Ceratolejeunea is one of the most natural genera of the Lejeuneae, and its distinctive characters were appreciated long before it was formally recognized as a genus. Apparently the West Indian *C. cornuta* (Lindenb.) Schiffn. * is the species which first appears in the literature. This was originally described as a *Jungermannia* † but a few years afterwards was referred to the genus *Lejeunea* by Nees von Esenbeck.‡ Meanwhile Dumortier had placed it in his newly proposed genus *Colura*, § of which the type species was *Jungermannia calyptrifolia* Hook. The two species are totally distinct in their vegetative structure, having little in common except their horned perianths, and even in these there are structural differences of importance. In spite of these facts, they are still kept together in the Synopsis Hepaticarum under the section *Ceratanthae* of the genus *Lejeunea.*|| The authors, however, divide this section into two subgroups, *Genuinae* and *Aberrantes.* The first of these corresponds exactly with the genus *Ceratolejeunea,* as now understood by most writers, and includes *C. cornuta* and about fifteen of its immediate allies. The second is a much more artificial group

* Bot. Jahrb. 23 : 583. 1897.

† Lindenberg, Nova Acta Acad. Caes. Leop.-Carol. 14, suppl.: 23. 1829.

‡ Naturg. der europ. Leberm. 3 : 265. 1838.

§ Recueil d'Obs. sur les Jung. 12. 1835.

|| *L. c.* 399. 1845.

[The Bulletin for May (32 : 235–272. *pl. 9–18*) was issued 27 My 1905.]

and includes species belonging to the two modern genera *Coluro-lejeunea* and *Leptolejeunea*. Many years later Trevisan * revived Dumortier's genus *Colura*, giving it the same limits as the section *Ceratanthae* of the Synopsis. The subsequent history of *Cerato-lejeunea* is the same as that of other genera of the Lejeuneae; it was first described as a subgenus by Spruce † and afterwards elevated to generic rank by Schiffner.‡

Ceratolejeunea is composed entirely of tropical and subtropical species and attains its highest development in the mountainous forests of America. A few species, however, are known from paleotropic regions and from the islands of the Pacific. The plants usually grow on rotten logs or on the bark of trees or shrubs but sometimes occur on shaded rocks or even on living leaves. As a rule, a given species is more or less particular in its choice of a substratum. In some cases the plants grow mixed with other hepatics but it is much more usual to find them in pure mats, which sometimes measure several feet in length. The stems are at first prostrate and cling closely to the substratum, but in old mats the plants become depressed-cespitose and often stratified in appearance and the branches assume a more or less parallel position.

Although classed among the Lejeuneae Schizostipae, the species of *Ceratolejeunea* are more robust than is usual in this group and are further distinguished by their olive-brown color and by their glossiness. The color is due to a pigmentation of the cell-walls and is sometimes pronounced enough to make the plants appear almost black; under other circumstances it is hardly sufficient to mask the green color of the chloroplasts. In their general appearance the plants bear a strong resemblance to certain genera of the Holostipae, such as *Lopholejeunea* and *Odontolejeunea*.

The leaves are imbricated, although rarely densely so, and the lobe is broad and falcate, spreading widely from the axis. In the majority of cases the lobe is convex and the apex more or less reflexed. The antical margin is rounded except in the basal region, but the postical margin is more variable, being sometimes slightly rounded, sometimes nearly straight and sometimes distinctly

* Mem. r. Ist. Lomb. III. 4: 401. 1877.

† Hep. Amaz. et And. 198. 1884.

‡ Engler & Prantl, Nat. Pflanzenfam. 1^3: 125. 1893.

incurved. The apex is usually broad and blunt but is frequently abruptly apiculate or acute. In some cases the margin of the lobe is entire throughout or indistinctly crenulate from projecting cells, in other cases it is more or less toothed, especially in the apical region, and in a few species it is sharply spinose. The leaves are exceedingly variable in certain species, and the degree of marginal dentation must always be used with caution as a diagnostic character.

Except near the base of the lobe, the leaf-cells are more or less convex, and their walls are strongly thickened throughout. The middle lamella appears as a fine but distinct line and is clearly visible without the use of reagents (PLATE 19, FIGURES 5, 15). The thickening is deposited upon this lamella in the form of a layer and is practically uniform over both horizontal and vertical walls except for the scattered pits connecting the cells (FIGURES 6, 16). Viewed from the surface of the lobe, the thickenings appear in the form of large and often confluent trigones with occasional intermediate thickenings. The degree of thickening often varies in a single species, and is apparently dependent upon external conditions. Ocelli can frequently be demonstrated; they differ from ordinary cells in their larger size, in their thin walls and in their more oily contents (PLATE 20, FIGURE 7). In the majority of the species they occur singly or in small irregular groups near the base of the lobe, but in at least one species they form a short row simulating a nerve. In certain species, the number and even the occurrence of ocelli is subject to variation, some of the leaves failing to develop them altogether.

The lobule when normally developed conforms very closely to that described for *Prionolejeunea* and for certain other genera of the Lejeuneae, the hyaline papilla being proximal in position and the apical tooth short and curved (PLATE 19, FIGURE 18; PLATE 20, FIGURES 10, 11, 24). The free margin of the lobule is involute to beyond the apex and appressed to the lobe, the apical tooth and the sinus helping to form the opening into the water-sac. The lobule is inflated throughout and is more or less curved in the outer part (PLATE 19, FIGURES 12, 13; PLATE 20, FIGURES 1, 3, 19).

The type of lobule just described is, however, subject to two modifications, both of which tend to increase the size of the water-sac. In the first the keel is so strongly arched that it is approximately semicircular in outline (PLATE 19, FIGURE 2). At the same time the free portion of the lobule, which is involute throughout its entire length and appressed by its surface to the lobe, shows a distinct fold of involution almost as strongly arched as the keel itself. The result is that the water-sac becomes almost spherical in shape and exhibits a very minute opening. The free margin of such a lobule is rounded and the apical tooth shorter than usual and nearly straight (FIGURE 9); the hyaline papilla maintains its usual position and appearance. With this first modification of the lobule, the lobe is sometimes as large as in ordinary leaves, but is often considerably reduced in size.

In the second modification of the lobule the peculiarities of the first are exaggerated, and the water-sac is several times larger than in normal leaves. Enlarged water-sacs of this type are described as "utriculi" and occur singly or in a pair at the base of a branch (PLATE 19, FIGURES 1, 4, 12, 14; PLATE 20, FIGURE 4). The keel is here so strongly arched that it forms rather more than a semicircle and is quite a little longer than the free margin. The free portion of the lobule is in the form of a small lamina, which varies in shape from rectangular to trapezoidal and is usually cut off square at the end. This lamina is revolute and concealed within the water-sac. Sometimes it is slightly concave and helps to form an oval opening into the sac; sometimes it is strongly concave and the opening becomes more nearly circular. The apex and the hyaline papilla are essentially the same as in the second modification. The free portion of the lobe is very greatly reduced in size.

Certain species constantly develop the normal type of lobule or produce the spherical modification only in exceptional cases; others show a preference for the spherical form but sometimes revert to the normal; still others exhibit both normal and spherical lobules in almost equal number. In certain species the utriculi are apparently never developed; in others they occur with greater or less frequency. In all probability the development of both spherical lobules and utriculi is dependent upon external conditions, but at the present time no definite statements to this effect can be made. Of course, under some circumstances the lobules fail to develop or present a very rudimentary appearance.

The underleaves are attached by an almost straight line of insertion and often show a rudimentary disc in the basal region, from which the rhizoids develop. They vary in shape from orbicular to broadly reniform, and the base varies from cuneate to deeply cordate. In the majority of the species the underleaves are bifid; in a very few species they are undivided. The margin is commonly entire.

The inflorescence in the genus seems to be almost equally divided between autoicous and dioicous. The archegonial branch varies greatly in length in most of the species, but is invariably subtended by one or two innovations, which are themselves often floriferous. The bracts are usually connate with the bracteole and sometimes with each other (PLATE 20, FIGURE 17). They are rarely much larger than the leaves and are often perceptibly smaller.

The perianth is perhaps the most striking feature of the genus. It is more or less obovoid in shape and abruptly narrowed into a short but distinct beak. In the lower part it is nearly terete; in the upper part the antical surface is plane or nearly so, but there are two distinct lateral keels and two postical keels. Each of these four keels grows out beyond the beak in the form of a hollow horn, which sometimes remains short and sometimes becomes nearly as long as the remainder of the perianth (PLATE 19, FIGURES 1, 12; PLATE 20, FIGURES 1, 2, 21). Such a horn is formed by the rapid growth and division of the cells in the upper part of the keel and shows at maturity a group of small and thin-walled cells at its apex, very different from the thick-walled cells found elsewhere in the perianth. On account of the delicacy of these cells, the horns often become irregularly torn at the apex but it is doubtful if they are ever normally toothed or spinose. In rare instances a fifth horn grows out from the base of one of the other horns and is supplementary to it. Of course, a five-horned perianth of this type is very different from that found in such a genus as *Leptolejeunea*, where the fifth horn is always antical in position.

Specialized organs of vegetative reproduction have not yet been observed in *Ceratolejeunea*. It is not unusual, however, for a leaf-cell to give rise directly to a leafy shoot or propagulum without the interpolation of a protonemal structure. This takes place more readily in a leaf which has become detached but sometimes occurs in an intact leaf. Propagula of this type are homologous with those described for *Plagiochila*.

Five species of *Ceratolejeunea* have been recorded from Puerto Rico. Three of these are mentioned in Hampe and Gottsche's list of Schwanecke's hepatics; namely, *L. ceratantha*, *L. patentissima* and *L. variabilis*.* The specimens referred to *L. ceratantha* have been examined by Stephani and also by Schiffner. Stephani makes them the type of his new *Ceratolejeunea Schwaneckei*; Schiffner finds in them a mixture of two species, the one indeterminable and the other referable to *L. variabilis*.† There is no very good evidence, therefore, that *L. ceratantha* has been really found on the island. In the paper on Puerto Rico hepatics published many years later by Stephani, two other species, *L. cornuta* and *L. spinosa* are added from the collections of Sintenis,‡ but the specimens referred to *L. cornuta* were afterwards described as *Ceratolejeunea Sintenisii* Steph. *L. cornuta*, therefore, should also be considered a doubtful member of the flora. In the collections made by the writer on El Yunque, both *C. spinosa* and *C. Schwaneckei* occur in abundance, and there are also specimens of a third species which is apparently undescribed. Heller's specimens of this genus are mostly sterile but add a few fragments of what seems to be *L.* (*Ceratolejeunea*) *brevinervis* Spruce. Seven species, therefore, are known with more or less certainty from the island, and it is probable that several others remain to be discovered.

CERATOLEJEUNEA SPINOSA (Gottsche) Steph.

Lejeunea spinosa Gottsche; G. L. & N. Syn. Hep. 402. 1845.
Colura spinosa Trevis. Mem. r. Ist. Lomb. III. **4**: 402. 1877.
Lejeunea (*Cerato-Lejeunea*) *spinosa* Spruce, Hep. Amaz. et And. 211. 1884 (excluding specimens described).
Ceratolejeunea spinosa Steph. Hedwigia **34**: 238. 1895.

Dark olive-green or brownish, growing in depressed tufts: stems 0.17 mm. in diameter, prostrate and loosely adherent to the

* Linnæa **25**: 355, 356. 1852.
† Bot. Jahrb. **23**: 582. 1897.
‡ Hedwigia **27**: 285, 291. 1888.

substratum, irregularly pinnate, the branches obliquely spreading, usually short but otherwise similar to the stem: leaves imbricated, the lobe more or less convex and inflexed at the apex, falcate-ovate, 0.85 mm. long, 0.6 mm. wide, antical margin nearly straight near base and stretching partly or wholly across axis, then somewhat curved to the apex, postical margin straight or nearly so, apex broad but usually acute, margin coarsely and irregularly toothed in the apical region, teeth mostly 8 to 10, variable in size, the smallest consisting of single projecting cells, the largest about three cells long and two cells wide at the base; lobule normally of the spherical type but often poorly developed, 0.25 mm. long, 0.2 mm. wide, hyaline papilla in a distinct depression, apical sinus very short and almost straight; utriculi occasionally present; cells of lobe averaging 19 μ at the margin, 23 μ in the middle and $46 \times 28\ \mu$ at the base, trigones large and often confluent, triradiate and rounded at the ends of the rays, intermediate thickenings occasional, subrotund in outline; ocelli usually absent but sometimes occurring singly at the base of the lobe: underleaves distant, orbicular, 0.35 mm. long, bifid about one half with erect triangular lobes separated by an acute to obtuse sinus, margins entire or vaguely crenulate or angular on the sides: inflorescence dioicous: female branch variable in length, sometimes much abbreviated, the flower subtended by one or rarely two simple and sterile innovations; bracts complicate, obliquely spreading, the lobe ovate, 1.1 mm. long, 0.7 mm. wide, acute, antical margin more strongly curved than the postical, irregularly spinose-dentate except near the base, the teeth mostly 10 to 20, lobule lanceolate to narrowly ovate or oblong, 0.75 mm. long, 0.25 mm. wide, margin toothed but with relatively fewer teeth than the lobe, apex acute to obtuse; bracteole connate on both sides, ovate, 0.75 mm. long, 0.4 mm. wide, bifid about one third with erect, triangular and acute lobes and a narrow sinus, margin as in the bracts but with smaller and fewer teeth; perianth immersed (except the horns), obovoid, 1 mm. long, 0.5 mm. wide, surface roughened by the convex cells, especially along the keels, beak short, horns about half as long as the main body of the perianth (0.35 mm.), contracted near the base, inflated and enlarged toward the rounded or bluntly pointed apex, more or less compressed, smooth, the two postical horns obliquely spreading, the two lateral widely spreading: ♂ inflorescence usually occupying a short branch, more rarely terminal on a longer branch; bracts in one to six pairs, inflated, shortly and subequally bifid with obtuse divisions and strongly arched keel; bracteoles at base of spike, similar to the underleaves but much smaller; antheridia single or in pairs: mature sporophyte not seen. (PLATE 19, FIGURES 1–11.)

On the bark of trees or on prostrate logs, more rarely on living leaves. El Yunque, *Evans* (*42, 61, 74, 97, 167*). Originally collected in Puerto Rico by *Sintenis* (*34, 35*). Widely distributed in the West Indies, the type locality being St. Kitts, where it was first found by *Breutel.* It has also been reported from the following islands: Guadeloupe, *L'Herminier;* Dominica, *Elliott, Lloyd;* Martinique, *Duss;* St. Vincent, *Elliott;* Cuba, *Wright.* The specimens from the Andes, described by Spruce as *L. spinosa*, do not belong to this species.

C. spinosa is characterized by its dentate leaves, usually destitute of ocelli, by its strongly inflated and subspherical lobules, by its small, orbicular underleaves, by its dioicous inflorescence, and especially by the peculiar horns of its perianth, which are enlarged and inflated near the tips and yet more or less compressed. In most species where the horns are elongated, they are terete and taper gradually to a point.

Under the name *C. spinosa* var. *flagelliformis*, Stephani * has described a peculiar but sterile plant from Martinique collected by Duss. It differs from the typical *C. spinosa* in its much looser habit, the leaves being distant and the branches slender and often microphyllous, in its lobules, which are either poorly developed or else conform to the usual type of lobule found in the genus, and in its underleaves, which are more deeply bifid. Female specimens of the same plant were collected by the writer on El Yunque (*101*), where it grew sparingly on bushes. In these specimens the underleaves are occasionally subcordate at the base. The plants present every appearance of being distinct from *C. spinosa*, but in the absence of perianths it would perhaps be unwise to separate them.

Ceratolejeunea valida sp. nov.

Olive-brown, growing in depressed mats: stems 0.17 mm. in diameter, elongated, irregularly pinnate, the branches usually short and widely spreading, not microphyllous: leaves imbricated, the lobe convex and inflexed at the apex, broadly falcate-ovate, 1.1 mm. long, 0.85 mm. wide, antical margin straight or nearly so near the base, then strongly arched to the apex, postical margin less strongly arched and almost straight near the keel, apex broad,

* Hedwigia 34: 238. 1895.

sometimes rounded but usually minutely apiculate and often bearing one or two additional teeth, margin otherwise entire; lobule always conforming to the normal type, narrowly ovate in outline, strongly inflated, 0.17 mm. long, 0.09 mm. wide, keel more or less arched, slightly roughened from projecting cells, forming an obtuse angle with the postical margin of the lobe, free margin of lobule straight or nearly so, apical tooth short and slightly curved, hyaline papilla in a slight depression, sinus lunulate; utriculi frequent, occurring singly or in pairs at the base of a branch, sometimes attaining a length of 0.65 mm., free lamina strongly concave and forming a cylindrical canal leading into the sac; cells of lobe averaging 14μ at the margin, 23μ in the middle, and 40 × 28μ at the base, trigones large and often confluent, triradiate and mostly truncate at the ends of the rays, intermediate thickenings occasional, approximately rectangular or quadrate in outline; ocelli not developed: underleaves distant to slightly imbricated, nearly plane, orbicular, 0.6 mm. long, rounded at the base, bifid about one third with erect, acute or subacute lobes and a narrow sinus, margin entire, rhizoids when present springing from a rudimentary disc: inflorescence dioicous: female branch very variable in length, the flower subtended by a single, short and often floriferous innovation; bracts complicate, obliquely spreading, the lobe ovate to orbicular-ovate, 0.85 mm. long, 0.6 mm. wide, apex rounded, apiculate or subacute, margin entire or irregularly toothed near the apex, lobule ovate-lanceolate to obovate, 0.55 mm. long, 0.35 mm. wide, rounded to acute at the apex, margin entire or sparingly denticulate in the upper part; bracteole somewhat connate on both sides, broadly ovate or oblong, 0.75 mm. long, 0.6 mm. wide, bifid about one third with erect acute lobes and a narrow sinus, margin entire or with a few scattered teeth; perianth immersed (except the horns), obovoid, 1 mm. long, 0.6 mm. wide, surface roughened especially along the keels, apex broad and with a short beak, horns nearly half as long as the main body of the perianth (0.3 mm.), cylindrical or slightly compressed at the blunt apex, smooth, the two postical horns erect, the two lateral erect or somewhat spreading: ♂ inflorescence and mature sporophyte not seen. (PLATE 19, FIGURES 12–20.)

On bushes. El Yunque, *Evans* (*91*).

It is with some hesitation that *C. valida* is described as new, partly because species are so difficult to define in *Ceratolejeunea*, partly because it is so closely related to the following species. Perhaps its most striking peculiarities are found in the leaf-cells with their extremely thick walls. When these cells are viewed from the surface, especially in a flattened leaf, they present an unusual appearance because their large trigones are truncate rather than rounded (FIGURE 15). The species is also noteworthy because it fails to develop ocelli and spherical lobules. These characteristics will help to separate it from *C. spinosa.* It also differs from this species in its entire or sparingly toothed leaves, in its larger underleaves, in its entire or less dentate bracts and bracteoles, and in the differently shaped horns of its perianth.

Ceratolejeunea brevinervis (Spruce)

Lejeunea (*Ceratolejeunea*) *brevinervis* Spruce, Jour. Linn. Soc. Bot. **30**: 342. *pl. 21. f. 6–9.* 1894.

On bark of trees and on rotten logs. North slope of the Luquillo Mountains, *Heller* (*1131 p.p., 4712 p. p.*). Also known from the following islands: Guadeloupe, the type locality, *L'Herminier;* Dominica, *Elliott;* Jamaica, *Evans.*

There is only one important respect in which *C. brevinervis* differs from *C. valida,* and that is in the possession of a false nerve running half way from the base to the apex of the lobe and consisting of a row of from six to ten ocelli. In some cases there is a second and shorter row lying next to the first. The ocelli average about 40 μ in length and seem to be entirely absent from the bracts. Heller's specimens are not typical, the horns of the perianth being shorter than usual, but this is probably because they are poorly developed.

CERATOLEJEUNEA SCHWANECKEI Steph.

Lejeunea ceratantha Hampe & Gottsche, Linnaea **25**: 356. 1852. (Not Nees & Mont.)

Ceratolejeunea Schwaneckei Steph. Hedwigia **34**: 237. 1895.

Varying in color from olive-brown to blackish, growing in depressed mats: stems 0.14 mm. in diameter, loosely appressed to the substratum, elongated, irregularly pinnate, the branches usually short and widely spreading, often with smaller leaves than the stem: leaves imbricated, the lobe convex and sometimes inflexed at the apex, falcate-ovate, 0.85 mm. long, 0.6 mm. wide, antical margin nearly straight near base, then strongly curved to the apex, postical margin varying from slightly outwardly curved to slightly incurved, often nearly straight, apex broad, sometimes rounded and entire, sometimes apiculate and sometimes with two to four irregular and scattered teeth, margin otherwise entire; lobule sometimes conforming to the normal type and sometimes spherical; normal lobule strongly inflated, ovate in outline, 0.17 mm. long, 0.12 mm. wide, keel arched, slightly roughened from convex cells, forming an obtuse angle with the postical margin of the lobe, free margin of lobule straight or nearly so, apical tooth short and blunt, somewhat curved, hyaline papilla in a scarcely evident depression; spherical lobules 0.2 mm. long, apical tooth short and rounded, papilla in a distinct depression; utriculi often present, singly or in a pair at the base of a branch, sometimes attaining a length of 0.5 mm.; cells of lobe averaging 14 μ at the margin, 22 μ in the middle and $35 \times 22 \mu$ at the base, trigones large and often confluent, triradiate and rounded at the ends of the rays, intermediate thickenings occasional, oval to rotund in outline; ocelli often but not always present, occurring singly or in a pair at the base of the lobe, averaging $46 \times 28 \mu$, not developed in the bracts: underleaves distant to imbricated, plane or convex when seen from below, varying in shape from orbicular and rounded or even cuneate at the base to broadly reniform and cordate at the base, 0.25–0.5 mm. long, 0.25–0.85 mm. wide, bifid one third to one half, the sinus narrow and usually acute, the divisions erect, triangular, acute to obtuse, margin entire: inflorescence dioicous: female branch variable in length but rarely very short, the flowers innovating on one or on both sides, the innovations usually short and simple; bracts complicate, obliquely spreading, the lobes ovate and connate antically at the base, 0.85 mm. long, 0.5 mm. wide, apex rounded or apiculate, margin entire or sparingly and irregularly toothed in the upper part, lobule ovate to ovate-lanceolate, 0.6 mm. long, 0.2 mm. wide, rounded to acuminate at the apex, margin usually entire but sometimes with a few scattered teeth in the upper part; bracteole connate on both sides, broadly ovate to orbicular, about 0.6 mm. long, bifid about one third with erect and acute lobes and a narrow sinus, margin entire or with one or two scattered teeth on each side; perianth immersed (except the horns), obovoid, 1.1 mm. long, 0.6 mm. wide, surface slightly roughened especially along the keels, apex broad and with a short beak, horns about 0.25 mm. long, terete and gradually tapering to the acute or bluntly pointed apex, smooth, the two postical horns erect or slightly spreading, the two lateral suberect to widely spreading: ♂ inflorescence occupying a short branch or terminal on a longer branch, sometimes proliferating at the apex; bracts mostly in three to six pairs, imbricated, strongly inflated, shortly and subequally bifid, the lobes bluntly pointed; bracteoles present at base of spike, orbicular, bifid; antheridia usually borne singly: mature sporophyte not seen. (PLATE 20, FIGURES 1–18.)

On bark of trees or on logs, rarely on rocks or on living leaves.

El Yunque, *Evans* (*26, 32, 71, 81, 118, 146, 147, 159*). North slope of the Luquillo Mountains, *Heller* (*4646*). Known only from Puerto Rico, where it was originally collected by *Schwanecke* and listed as *L. ceratantha* Nees & Mont.

The specimens quoted above have been compared with a portion of the type material of *C. Schwaneckei*, kindly communicated by its author. The species is exceedingly variable, and it is not unusual to find the whole range of variation exhibited by a single plant. The variation shows itself in the apices of the lobes, in the degree of marginal dentation, in the lobules, in the degree of thickening in the walls of the leaf-cells, in the presence or absence of ocelli. It is in the underleaves, however, that it reaches its height. In some cases these are orbicular, scarcely wider than the stem and cuneate at the base; in other cases they are broadly reniform, six times as wide as the stem and deeply cordate at the base. Between these two extremes there are all possible gradations. The bracts and bracteoles are also variable with respect to shape and degree of dentation, but they agree in being always connate with one another, thus forming a second and deeply lobed sheath around the true perianth. The horns of the latter organ do not vary to any extent except in the direction which they assume.

The utriculi are often found at the base of short and simple branches, the remaining leaves of which have spherical lobules and reduced lobes (FIGURE 4). Lobules of this sort, however, are by no means confined to such positions but frequently occur on leaves with normal lobes, either on the main stem or on leading branches.

It is not difficult to distinguish *C. Schwaneckei* from any one of the preceding species. From *C. spinosa* it may be separated by its less strongly toothed leaves and bracts, by the fact that it often develops lobules of the normal type, by the variability in the shape of its underleaves and by the tapering horns of its perianth. From *C. valida* and *C. brevinervis* it may be distinguished by the rounded thickenings of its leaf-cells, by the spherical lobules which it so often develops and by its variable underleaves.

CERATOLEJEUNEA VARIABILIS (Lindenb.) Schiffn.

Lejeunea variabilis Lindenb.; G. L. & N. Syn. Hep. 399. 1845.

Colura variabilis Trevis. Mem. r. Ist. Lomb. III. **4**: 402. 1877.

Lejeunea (*Cerato-Lejeunea*) *variabilis* Spruce, Hep. Amaz. et And. 206. 1884.

Ceratolejeunea variabilis Schiffn.; Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 125. 1893.

On bark of trees, on rotten logs, on living leaves and on rocks. Without definite localities, *Schwanecke*, *Sintenis*. The species is said to be widely distributed in the American tropics, and the following stations may be quoted: St. Kitts, the type locality, *Breutel*; Dominica, *Elliott*; Martinique, *Husnot*; St. Vincent, *Elliott*; region of the Amazon, *Spruce*. No specimens from Puerto Rico have been seen by the writer.

C. variabilis is very closely related to the preceding species but differs from it in its autoicous inflorescence. Whether this single difference is sufficient to separate the species is a question which cannot be answered definitely at the present time.

Ceratolejeunea Sintenisii Steph.

Lejeunea cornuta Steph. Hedwigia **27**: 285. 1888. (Not Lindenb.)

Ceratolejeunea Sintenisii Steph. Hedwigia **34**: 237. 1895.

Olive-brown, prostrate and loosely adherent to the substratum: stems 0.1 mm. in diameter, elongated, densely and irregularly pinnate, the branches mostly short and widely spreading, sometimes with smaller leaves than the stem: leaves imbricated, the lobe convex and more or less inflexed at the apex, falcate-ovate, 0.7 mm. long, 0.45 mm. wide, antical margin arching across the axis, rounded from very near the base to the apex, postical margin straight or nearly so, apex broad, rounded or bluntly pointed, margin entire or very minutely crenulate from projecting cells, sometimes angular-repand in the outer part; lobule conforming to the normal type, strongly inflated, broadly ovate in outline, 0.12 mm. long, 0.09 mm. wide, keel arched, almost smooth, forming an obtuse angle with the postical margin of the lobe, free margin of lobule somewhat curved, apical tooth short and blunt, slightly curved, papilla in a shallow depression, sinus lunulate; utriculi occasionally present at the base of short branches, occurring singly, 0.35 mm. long; cells of lobe averaging 13μ at the margin, 20μ in the middle and 30 × 20μ at the base, trigones large, triradiate and rounded at the ends of the rays, often confluent, intermediate thickenings occasional, oval; ocelli developed singly or in pairs at the base of the lobe, $46 \times 23\mu$, not always present: underleaves imbricated, plane or convex from below, reniform, maximum size 0.5×0.7 mm., rounded to cordate at the base, bifid one fourth to one half with erect, acute to obtuse divisions and a narrow sinus, margin entire or nearly so: inflorescence autoicous: female branch variable in length and sometimes much abbreviated, the flower innovating on one side with a short and often floriferous innovation; bracts complicate, obliquely spreading, the lobe ovate to obovate, 0.6 mm. long, 0.45 mm. wide, rounded to obtusely pointed, entire or minutely crenulate, lobule oblong or ovate, 0.45 mm. long, 0.15 mm. wide, rounded to acute, entire or nearly so; bracteole slightly connate on both sides, broadly ovate, 0.6 mm. long, 0.5 mm. wide, bifid one fourth to one third with erect acute lobes and narrow sinus, margin entire or minutely crenulate; perianth about half exserted, ovoid, 0.85 mm. long, 0.35 mm. wide, beak short, surface smooth except along keels, horns about 0.15 mm. long, terete, tapering to blunt points, obliquely spreading: ♂ inflorescence occupying a short branch; bracts loosely imbricated, in three to six pairs, strongly inflated, shortly and subequally bifid, the lobes blunt; bracteoles present at base of spike, rotund, shortly bifid: mature sporophyte not seen.

Near Jabucoa, *Sintenis* (*125*), the type locality.

The description given above is drawn from a portion of the type specimen kindly communicated by Stephani. Although this specimen shows that the species is probably distinct, it does not bring out clearly the range of variation, and it may be necessary to modify the description in certain details when the plant becomes better known. For this reason it has seemed inadvisable to figure the species at the present time.

C. Sintenisii is somewhat smaller than the preceding species and is more densely pinnate. In its autoicous inflorescence it agrees with *C. variabilis* but differs from all the other species known from the island. It may also be distinguished by the absence of teeth on the leaves and bracts and by the shorter horns of the perianth.

Ceratolejeunea patentissima (Hampe & Gottsche)

Lejeunea patentissima Hampe & Gottsche, Linnaea **25**: 355. 1852.

Lejeunea (*Harpalejeunea*) *patentissima* Steph. Hedwigia **27**: 288. 1888.

Dark olive-brown, scattered: stems 0.08 mm. in diameter, irregularly pinnate, the branches obliquely spreading, not microphyllous: leaves loosely imbricated, the lobe subsquarrose, convex, strongly falcate, broadly ovate or subrotund beyond the lobule, 0.35 mm. long, 0.3 mm. wide, antical margin straight or slightly incurved near base, then very strongly outwardly curved to the apex, postical margin much shorter, more or less curved, apex broad, rounded or apiculate, margin entire or vaguely crenulate from projecting cells; lobule of the normal type, strongly inflated, narrowly ovate in outline, 0.17 mm. long, 0.08 mm. wide, strongly curved forward in the outer part with a narrow tubular opening into the water-sac, keel somewhat arched, slightly roughened, forming approximately a right angle with the postical margin of the lobe, free margin of lobule slightly curved, apical tooth rather long and tapering, abruptly curved at the base, normally reaching to the end of the keel, papilla in a distinct depression, sinus short and shallow; cells of lobe averaging 13 μ at the margin, 18 μ in the middle and $28 \times 18\ \mu$ at the base, trigones large and often confluent, triradiate and with truncate rays, intermediate thickenings occasional, also truncate, walls often appearing uniformly thickened on account of the minute pits; ocellus when present single, at base of lobe, $41 \times 25\ \mu$: underleaves distant, appressed to distinctly squarrose, orbicular, 0.2 mm. long, bifid about one third with an acute sinus and erect or subconnivent, obtuse to acute lobes, margin entire or nearly so: inflorescence dioicous: ♀ inflorescence innovating on one side; bracts complicate, obliquely spreading, the lobe very much as in the leaves with the antical margin much longer than the postical, 0.7 mm. long, 0.5 mm. wide, lobule (in single specimen seen) obovate, 0.5 mm. long, 0.2 mm. wide, broad and apiculate at the apex, entire; bracteole connate on both sides, ovate, 0.6 mm. long, 0.4 mm. wide, bifid about one third with narrow sinus and erect lobes, acute or obtuse at the apex; perianth almost immersed, obovoid, 0.7 mm. long, 0.45 mm. wide, beak short, horns short and rounded, scarcely flattened, suberect: antheridial spike (the only one seen) occupying a short branch; bracts in three pairs, shortly and subequally bifid with rounded or obtuse lobes; bracteole single at base of spike, similar to the underleaves. (PLATE 20, FIGURES 19–26.)

Mixed with other bryophytes. Puerto Rico, *Schwanecke*. The species has apparently not been collected on the island a second time. It has, however, been found in Cuba by *Wright*, and a few fragments of it occur in the writer's set of the *Hepaticæ Cubenses*, mixed with the specimens distributed as *Lejeunea ceratantha*. It has not been reported from any other localities.

Reference has already been made to this species in the discussion of the genus *Harpalejeunea*.* Unfortunately the specimens preserved as the type do not agree in all respects with the original description, the most important discrepancy being with regard to the perianth, which is said to be five-keeled at the apex. The single perianth studied by the writer is in the Hampe herbarium and is mounted on mica, so that it was apparently seen by the authors of the species. This perianth, as shown by FIGURE 21, has four blunt horns, and it would therefore appear that the original description is incorrect in attributing to the plant a five-keeled perianth. Stephani † has described a specimen of this species, also presumably a part of the type, which differs somewhat from the normal form. This specimen is said to have distant leaves with the lobe squarrose, ovate-lanceolate, and sharply pointed. A drawing of this peculiar plant, which he has kindly supplied, shows these differences clearly but agrees with the specimens described above in its lobules and underleaves. Whether it represents an admixture of another species or is simply a slender and poorly developed form of *C. patentissima* can hardly be determined.

C. patentissima is the smallest form of the genus known from Puerto Rico. The slender lobule, distinctly curved forward in the outer part, is perhaps its most striking feature. At the junction with the lobule the postical margin of the lobe curves abruptly inward, the consequence being that the outer end of the water-sac, enclosing the tubular canal, seems to be entirely free from the lobe (FIGURE 19). The true conditions can be made out only by dissection. The lobule apparently exhibits no modifications, neither spherical lobules nor utriculi having been observed. Aside from the peculiarities in the lobule, the species is remarkable for its squarrose and strongly falcate lobes, for the lack of teeth on its leaves and bracts and for its small orbicular underleaves. The walls of the leaf-cells, also, are unusual on account of their minute pits, many of the cells being apparently thick-walled throughout (FIGURE 22).

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* Bull. Torrey Club 30: 547. 1903.

† Hedwigia 27: 288. 1888.

It will be seen from the foregoing discussion that our knowledge of the species in this difficult genus is still far from complete. At the present time it is often quite impossible to determine whether differences are specific in value or merely due to variation. Apparently the plants will have to be studied in the field as well as in the laboratory, to learn if possible something about the causes which induce variation in them, before we can hope for definite conclusions on certain disputed points.

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Explanation of plates 19 and 20

The figures were drawn by the writer and prepared for publication by Miss Hyatt.

PLATE 19

Ceratolejeunea spinosa (Gottsche) Steph. 1. Part of plant with perianth, postical view, × 24. 2. Part of stem, postical view, × 24. 3. Section through lobule, cut parallel with the stem, × 45. 4. Utriculus, antical view, × 35. 5. Cells from middle of lobe, × 265. 6. Section through cells of lobe, × 200. 7. Cells from antical margin of lobe, × 200. 8. Cells from apex of lobe, × 200. 9. Apex of lobule, × 200. 10. Apex of underleaf division, × 200. 11. Bracts and bracteole, × 24. The figures were all drawn from specimens collected by the writer (*97*).

Ceratolejeunea valida Evans. 12. Branch with perianth, postical view, × 24. 13. Part of stem, postical view, × 24. 14. Base of branch with utriculi, antical view, × 24. 15. Cells from middle of lobe, × 265. 16. Section through cells of lobe, × 200. 17. Apex of lobe, × 200. 18. Apex of lobule, × 200. 19. Apex of underleaf division, × 200. 20. Bracts and bracteole, × 24. The figures were all drawn from the type specimen.

PLATE 20

Ceratolejeunea Schwaneckei Steph. 1. Branch with perianth, postical view, × 24. 2. Another branch with perianth, postical view, × 35. 3. Part of stem, postical view. × 24. 4. Branch with utriculi, postical view, × 35. 5. Apices of lobes, × 45. 6. Cells from middle of lobe, × 265. 7. Cells from base of lobe with two ocelli, × 200, 8, 9. Apices of lobes, × 200. 10, 11. Apices of normal lobules, × 200. 12. Apex of spherical lobule, × 200. 13, 14. Apices of underleaf divisions, × 200. 15. Bracts and bracteole, × 24. 16. Bracteole with lobules of bracts, × 24. 17. Bracts and bracteole, the latter on the left, × 24. 18. Bracts and bracteoles, × 24. The figures were all drawn from specimens collected by the writer (*26*, *146* and *189*).

Ceratolejeunea patentissima (Hampe & Gottsche) Evans. 19. Part of stem, postical view, × 35. 20. Part of stem, antical view, × 35. 21. Perianth with bracts and bracteole, × 35. 22. Cells from middle of lobe, × 265. 23. Apex of lobe, × 200. 24. Apex of lobule, × 200. 25. Underleaf, × 200. 26. Apex of underleaf division, × 200. Figures 22 and 24 were drawn from Wright's Cuban specimens; the others were all drawn from the type specimen.

A summary of Charles Wright's explorations in Cuba

Lucien Marcus Underwood

The botanical explorations of Charles Wright in Cuba laid the foundation for our knowledge of the flora of that island, but have left much to be discovered. As will be seen by the following summary, his travels were confined chiefly to the two ends of the island, leaving the great central portion largely unexplored. It is very unfortunate that the labels on his plants, at least in most of the collections where they are to be found, bear only the inscription "Cuba" or "in Cuba orientali." A serial catalogue of Wright's numbers would be of great value, made up from the data on some of the collections where they are to be found. For example, the ferns in Eaton's collection at New Haven bear the data with a much greater degree of fullness, written in from Wright's field-notes, and as Eaton published on the ferns of Wright's collections it is probable that his collection is fuller than any other in existence.* Probably the Grisebach collection of spermatophytes at Göttingen is the most complete for this group, but that of Sauvalle (now at the Estación Central Agronómica in Cuba) is very complete and is said to contain notes showing localities, as would be natural considering the plan Wright had in mind to prepare a flora of the island in connection with Sauvalle.

It appears from Wright's correspondence that a considerable portion of his collection was lost, mainly that collected in the rich tobacco region of the western end of the island (Pinar del Rio). How extensive this loss may have been, probably cannot now be estimated, but it was certainly considerable.† Wright's sojourn

* Dr. Gray (Am. Jour. Sci. III. 31 : 12. 1886) says that the collection at the Gray Herbarium is "the fullest set," but the ferns at least are better represented at New Haven.

† It seems probable that this loss must have been very great, for we are surprised at the numbers included in his sets. His numbers do not run much above 3,900, and with a flora so large as that of Cuba it seems singular that a professional collector in ten years should not have reached a much higher number, especially as there are numerous duplicates in his collection, at least among the groups of plants with which the writer is mostly concerned. The lower cryptograms were not numbered serially and he

in Cuba covered a period of nearly ten years. He arrived in Santiago de Cuba 25 November 1856, and returned to New York 9 September 1857. His second voyage brought him to Santiago 30 November 1858 and he left Havana for New York 28 July 1864. His third trip commenced in May 1865 and he returned in July 1867.

In order to determine more accurately Wright's exact route in Cuba, the writer applied to Miss M. A. Day, the librarian of the Gray herbarium, for information regarding Wright's field notes or other sources of information that might exist at Cambridge. Through her kind intervention, it was made possible to examine the extensive series of letters written by Wright, during his long residence in Cuba, to Dr. Asa Gray. These are now in the possession of Mrs. Gray and it is owing to her generosity that we were able to consult at our pleasure the long series, which consists of some two hundred finely written and often long-continued letters which are full of valuable notes on the flora. The time will come when the publication of these letters, or excerpts from them, will form a valuable commentary on Cuban plants. The tedious perusal of these letters was diversified by Wright's accounts of his experiences, some of which were almost the duplicate of our own, and more especially by the side-notes on the political situation existing in our country during the stormy and tumultuous period of the Civil War (1861–1865). It would appear that Wright was a northern Democrat, and his previous travels in the South had led him to understand the problem from a broader standpoint than many of the residents of New England, whose bias was in great measure due to this lack of exact information of the real situation, and his vigorous statements were evidently called forth by equally strong sentiments from his correspondent.

As we are concerned at present only with the matter of Wright's itinerary, we will cite only the dates and localities where the letters were written, with sufficient of the context to explain the locality and the direction of the course of exploration.

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was also engaged part of the time in collecting shells and other things, especially after he met Gundlach. In Dr. Gray's *Letters* (**2** : 555) these sentences explain the cause of the loss : "April 8th. It grieves my heart and will grieve yours badly when I tell you that your boxes were put under a cargo of wet sugar, which drained into them and have [*sic*] ruined the collection. . . . As to specimens to dispose of, say only one-half or one-third of the whole mass is left fit for it."

Map illustrating Charles Wright's explorations in Cuba

This list of Wright's stations has been submitted to Professor F. S. Earle, Director of the Estación Central Agronómica at Santiago de las Vegas, Cuba, whose familiarity with the country has enabled him to locate certain places and estates on the map of Cuba that would have been impossible to one less familiar with the geography of the region. In time, it may be possible to locate with accuracy the remaining stations, which are as yet unknown except from the brief and often unsatisfactory hints in Wright's correspondence. The notes added by Professor Earle to the account are marked with his initial — E.

SUMMARY OF CHARLES WRIGHT'S CORRESPONDENCE WITH ASA GRAY

I

1856.	25 N	Santiago.
	6 D	Cobre; written on third day of stay at that place.
	18 D	Filantropia (Mr. Bradford's estate) 12 miles from Cobre "among the mountains."
1857.	15 Ja	Filantropia.
	7 F	Filantropia. Mentions "two high points near here," viz., Nima-nima* and Loma del Gato.
	6 Mr	Filantropia. Speaks of going to Saltadero.
	9 Mr	Filantropia. Had finished packing; had visited 4 plantations.
	14 Mr	Cobre.
	3 Ap	Santa Catalina de Guaso or Saltadero (back of Guantanamo harbor). [Probably = Caimanera. — E.]
	5 Ap	Santa Catalina.
	23 Ap	Monte Verde.
	3 My	" "
	8 My	Saltadero. [Probably the same as Caimanera, the seaport of Guantanamo. — E.]
		[Here occurs a hiatus of four months in the correspondence.]
	9 S	At sea approaching New York.

II

1858.	30 N	Santiago de Cuba.
	5 D	Monte Verde. "Arrived here on 3d."
	17 D	" "
1859.	1 Ja	" "
	17 Ja	" "
	2 F	" "
	15 F	" "
	26 F	" "
	8 Mr	" "
	26 Mr	" "

* See below, under Madelina.

10 Ap Monte Verde.
24 Ap " "
14 My Monte Verde. Had collected at La Perla, a neighboring plantation; also speaks of being "within two or three minutes' walk of the virgin forest in every direction."
21 My Monte Verde.
1 Je Santa Catalina de Guantanamo.
9 Je Monte Verde.
21 Je " "
29 Je " "
5 Jl " "
12 Jl " "
16 Jl " "
5 Au " "
19 Au " "
31 Au " "
14 S " "
17 O Santiago de Cuba. "Waiting for money" [apparently a chronic condition].
6 N Josephina, a hacienda or plantation belonging to the owner of La Perla, three leagues east from Nouvelle Sophie.
17 N Nouvelle Sophie. Mentions two excursions to the Farallones from base to summit. [Probably the high mountains east of Santiago. — E.]
22 N Nouvelle Sophie. Mentions having left Monte Verde about 17 September.
26 N Nouvelle Sophie. Says "protracted stay not advisable."
9 D La Madelina, "right at foot of Nima-nima." "Mr. Baitaill tells me that the crest which I have all along on Mr. Bradford's authority called Nima-nima, is La Guinea and that the former is away over towards the seashore."
24 D La Madelina. Mentions being at La Guinea 14th and 18th.
26 D " "
1860. 10 Ja Santiago de Cuba. Speaks of going to-morrow to Guantanamo, then to Monte Verde and back by Nouvelle Sophie.
14 Ja Monte Verde. "Came from Guantanamo the 11th."
18 Ja Nouvelle Sophie.
21 Ja Santiago de Cuba.
2 F Filantropia.
24 F Nouvelle Sophie. "To-day I start for Monte Verde."
26 F Monte Verde. Speaks of plan for excursion to Mayari.
15 Mr Monte Verde. "I hope you wont let Eaton cut up these fern stems into cross sections. It seems to me simply ridiculous to attempt to exhibit the structure of a fern or palm by a cross section at any part, whereas a longitudinal section of either shows it perfectly, or the whole of it."
23 Mr Monte Verde.
8 Ap " "
16 Ap " "
1 My " "
4 My Monte Verde. "Monte Verde is nothing but a coffee estate."
[In suggesting labels Wright designates localities under judicial districts "which everybody knows" as follows:

Monte Verde = Yateras.
La Guinea = Ongolosongo [Hongolosonga. — E].
Filantropia = "
Nouvelle Sophie = Las Yaguas.
Josephina = Ramon].

17 My Monte Verde.

14 Jl " "

1 Au Mayari. Mentions conditions of life at Cayo del Rey, where he spent some time.

18 Au Holguin. "Arrived this morning."
(Wright apparently crossed the island directly north of Santiago and then along the north side of the island to Holguin).

22 Au Barajagua. "Left Holguin 19th and arrived here same day."

25 Au Hato del Medio. [Four miles N. W. of Alto Cedro — E.]

9 S Nouvelle Sophie. "Arrived in Cuba (= Santiago de Cuba) the 6th.

13 S Saltadero.

15 S Monte Verde.

18 S Monte Verde. "Start to-morrow for Nouvelle Sophie, thence to Cuba and Bayamo and I may go from there to Holguin."

19 S Saltadero.

20 S Saltadero. "Yesterday started for N. Sophie etc. expecting to get money in Saltadero or Cuba. To-day returned here in chase of that valueless certificate."

17 N San Juan de Buenavista. "S. W. by S. 7 leagues from Bayamo." [Probably S. E. instead of S. W., Buena Vista on new map is about 7 leagues S. E. of Bayamo.—E.]

26 N Bayamo. "Came this morning." *

16 D Nouvelle Sophie. "On my way from Bayamo I turned aside and spent two weeks at Bradford's [Filantropia]. Found a few good things at La Guinea and Loma del Gato."

1861. 4 Ja Monte Verde.

19 Ja " "

27 Ja Nouvelle Sophie.

4 F Monte Verde.

2 Mr " "

13 Mr Potosi (in Mt. Toro). "I am on an excursion through Monte Libano and Monte Toro." [Probably north of Monte Verde.—E.]

25 Mr La Catalina near Sagua de Tanamo. "Tremendous farallones all around us not so easy to climb as you might imagine."

5 My Monte Verde. "Hope to be off to-day or to-morrow for Baracoa."

3 Je Baracoa. "I came from Mata [Probably S. W. of Baracoa; on new map, Mata Cafee.—E.] yesterday, a terribly boggy place and apparently filthy enough to kill mud-turtles. I stood it two weeks or more and I am in good health." * * * "The streams are up preventing me going to the Yunque. † So soon as I can I shall pay it a visit,

* Dr. Gray (Am. Jour. Sci. III, 31 : 12. 1886) says "his kind host, Dr. Don Manuel Yero, assisted him in making some profitable mountain excursions." Judging from the above dates these must have been very brief.

† El Yunque—the anvil—is a flat-topped mountain six miles from Baracoa—one of the most conspicuous features of the sky line of eastern Cuba.

which will probably detain me but a few days. Then I shall return to Guantanamo stopping a day or two in the cuchillas (mountains)."

24 Je Monte Verde. "Got home yesterday tired out and my horse more so, seven days from Baracoa collecting a little by the way."

29 Jl Monte Verde. "After resting etc. I went on the road to Baracoa as far as the point where it turns northward to cross the mountains."

7 Au Monte Verde.

12 Au " "

4 S " "

5 O Valparaiso. "Just on the edge of Monte Libano." [Seven miles due west of Monte Verde.—E.]

17 O Monte Verde. "Got back yesterday."

24 O " "

24 N Nouvelle Sophie. "On the 20th I set out on my journey which if I am prospered will end at least for a time at "la Habana."

3 D Filantropia. Mentions a day on La Guinea. [Wright then went *via* Saltadero.]

13 D Mentions three excursions on La Guinea and Loma del Gato.

16 D Bayamo. The letter was mailed from Bayamo the 17th.

1862. 2 Ja Sancto Spiritos (Santo Espiritu).

4 Ja Sancto Spiritos "Shall remain a few days" * * * "There are as many as six or eight species of palms abundant along the route I have come, several of which I have not collected."

1 F Ingenio Fermina. "Fermina is a sugar estate two leagues from Bemba" [= Jovellanos.—E.] * * * "Left Santo Espiritu the 16th." [Here Wright found Gundlach, the zoologist, with whom he made many excursions.] In this letter Wright speaks of coming to an ingenio (sugar estate) the 24th where he stayed four or five days and "the next day here." Four leagues before reaching Villa Clara he mentions coming to a very hilly savanna.

23 Mr Mejia. "In my last [there is, however, no mention of this in any letter present in the collection] I told you I was going to the Cienaga de Zapata. I am domiciled about three leagues from it — have been to it twice." [Probably S. of Navajas. — E.]

28 Mr Mejia. "Returned from another excursion to the Cienaga." [Here occurs a brief hiatus in the correspondence.]

17 Je San José [In Pinar del Rio, near Taco Taco or Santa Cruz. — E.] [This place is mentioned in a previous letter as away S.W. of Habana.] "I have been here more than three weeks with Don José Blain, who takes some interest in botany." . . . "I was there (Habana) the last days of May. It's a nasty place." . . . "I am about 20 leagues westward of Habana right at the foot (south side) of Rangel range of mountains or Los Organos."

23 Je "Returned from a visit of two or three days to Retiro, the other place Don José mentioned, when I was in Habana six days."

4 Au Santa Cruz. "Day before yesterday returned from an excursion of a few days south and west of here into the savannas, pinales and the famous 'vueltabago' — the tobacco district." [Properly vuelta abajo.]

13 Au San José.
8 S " "
28 S San José. "Three weeks ago went on an excursion northward and westward; we were gone two weeks."
13 O San José. "Gundlach will send my horses to Guanajay 15 leagues this side of Habana so probably I shall not go there now."
25 O Habana.
29 O San José. "To-day completes my fifty-first year."
27 N San José "Last month went from Guajaibon to Las Posas to Toscana a finca of Sauvalle (seaside) returning by San Marco and San Diego de Bañon. From there I turned S.W., and went to Herradura and Consolacion returning by Almacigos, Hato Queniando, Herradura, San Diego and so home."
10 D Ingenio Esperanza, "about a league from Pinar del Rio."
13 D Langvanillas. [This was probably the residence of an engineer of the above mentioned 'ingenio' about "four leagues away" where Wright mentioned having been invited to go in the last letter.]
1863. 9 Ja San José.
13 F " "
21 F " "
31 Mr " "
10 Ap " "
30 Ap Habana.
14 My — Wright had been at Fermina "for a few days to get plants Gundlach could not bring."
25 My Concordia. "Came here ten days since." Mentions going to the coast three leagues afoot. "Shall return in a few days to San José or rather Retiro whither friend Blain has now removed — a league."
15 Je Retiro. [This is the name of a finca near Taco Taco where Don José Blain lived. — E].
15 Jl Retiro.
27 Jl Toscano. [Probably the name of a finca near the N. coast, somewhat E. of Bahia Honda. — E]
5 S Retiro.
20 S "
20 D Los Remales. "The latter part of October I crossed the mountains to the north coast to Toscano, stayed there till Nov. 15. Went to Sagua (vega) climbed Guajaibon twice; made excursion to Cajalbarra (pine ridge crossing the island) followed down the north side near the coast through La Palma, Nombre di Dios, Bajas, Mantua. From Asiento viego (the Laguna) followed the same road to the Jarela, the terminus of my travels last year." He mentions wanting to go to the cape (Cape Corrientes?) "but as there was no guide I was content to go to a point on the south coast four leagues afoot."
1864. 15 Ja Retiro. "Three days ago I returned from my excursion of eighty," "Wrote 20th from Los Remales: a day or two later went to La Grife." [In this letter Wright mentions a serious experience with some poisonous plant which caused temporary loss of eyesight.]
5 F Retiro.

14 F Retiro
7 Mr "
22 Ap "
30 Ap Retiro. "On the 25th went to the coast at a point called Daranigan. [Point on the coast west from Retiro.—E]
7 My Retiro. "Yesterday went to the hills."
19 My Retiro. "Made an excursion of ten days eastward and southward to La Concordia, San Leon, etc."
27 Jl Habana. "Came here on the 21st."
28 Jl Habana. "Passport in pocket-book, plants boxed ready to embark,"
1865. 13 Ap Weathersfield, Conn. "Shall start for Cuba before the end of the month."
24 Ap Weathersfield, Conn.

III.

9 Je* Cayo Bonito. "Down here on the edge of that grand swamp, the Cienaga de Zapata just south of Matanzas.
18 Je La Fermina; "returned yesterday."
9 Jl Matanzas.
24 Jl Janta. "Came here five or six days ago." . . . "Stayed some ten or twelve days at Palma Sola." [Probably near Matanzas or Jovellanos.—E.]
15 Au Matanzas.
4 S Habana.
21 S Balestina. [At this place the name is spelled Valestina.] † [Province of Pinar del Rio.—E.]
23 O "
7 D "
1866. 25 Ja "
13 F "
17 F "
15 Mr Retiro.
25 Mr "
3 Ap Retiro.
8 Ap Toscano.
14 Ap "
29 Ap "
2 Je Retiro. "Left Toscano at 3 m. and arrived here about sunset."
15 Je Retiro. "Went to Rangel on the 8th" . . . "*He* went again to San Cristobal on the 10th."
4 Jl Retiro.
23 Jl "
8 Au "
14 Au Retiro. "Have been making short excursions of two or three days at a time into the palm and pine savannas near the coast."

* Dr. Gray *loc. cit.* speaks of this third trip as commenced "in the autumn of 1865." In Gray's letter to Charles Wright (Letters, **2**: 540) he mentions receiving a letter from Wright at Habana dated May 9th.

† Gray *loc. cit.* says "Balestena" and speaks of it as "a cattle farm at the southern base of the mountains opposite Bahia Honda."

20 Au Retiro.

26 S "At a sawmill the last two weeks at Palacios" [near Pinar del Rio ?].

10 O La Machina (this is the sawmill above mentioned).

28 O Habana.

6 N Retiro. "Spent some days in Concordia."

2 D "

4 D Retiro. "Yesterday went into the mountains" (La Palma Vega).

12 D La Machina. (Various additions to this letter were made from same place at various dates up to 20 D.)

26 D Arroyo Hondo. "To-morrow I go to Luis Lazo."

1867. 1 Ja Guane. "From Arroyo Honda I went to Luis Lazo and staid a few days."

6 Ja La Grifa.

10 Ja Los Portales de Guane. "Yesterday I left La Grifa."

21 Ja Retiro.

8 F Habana.

10 F Habana. "Went to Matanzas yesterday for money."

18 F Habana. In this letter Wright recounts troubles he had to get a passport and other papers necessary to embark for Trinidad.

19 F Habana. "Everything arranged for my voyage" [to Trinidad]. [Apparently there is a hiatus in the correspondence here].

20 Ap Trinidad. "Since I last wrote you I went in the mountains to an old cafetal now a potrero or pasture. . . . "I came here about a week ago."

24 Ap Cuba (= Santiago de Cuba).

26 Ap Sta. Catalina de Guantanamo. "Arrived this morning." In this letter Wright mentions "letter of 8th" telling of loss of "great collections of the Vueltabago." *

5 My Monte Verde. "Back again."

12 My " †

The next letter is dated Cambridge, Mass., 23 Nov. 1868, in which Wright says "Done distributing." The sets of Cuban plants run thus: 2250, 2200, 2075, 1715, 1550, 1460, 1330, 1275, 1165, 960, 780, 750, 660, 620, 560.

The only breaks in the continuity of the above correspondence are as follows:

1. That from 8 May 1857 at Saltadero to 9 September 1857 written on the steamer approaching New York. This is the longest hiatus, and what may have been Wright's journeys during this period is largely a matter of conjecture. It seems probable that this time, like the rest of his first expedition, was spent on two or three of the plantations that formed the basis of his principal explorations in the province of Santiago.‡

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* *Cf.* foot-note p. 292.

† Dr. Gray (*loc. cit.*) says that Wright returned from his third visit in July 1867.

‡ Wright's single letter to Dr. Torrey during this period, preserved in the Torrey correspondence at the New York Botanical Garden, is dated 20 June 1857 from Monte Verde and bears out the above supposition.

2. That from 28 March 1862 written near the great swamp south of Matanzas (Cienaga de Zapata) to 17 June 1862 written from the province of Pinar del Rio, where he speaks of having been for "more than three weeks." There is still a hiatus of about two months concerning which we can only conjecture. It seems unlikely that this time was spent other than in the Matanzas province.

3. That from 19 February 1867 to 20 April 1867. At the former date Wright was at Habana making arrangements for a voyage to Trinidad on the south coast, and in the second he was engaged in collecting at Trinidad himself. It would seem that one intermediate letter at least was lost. It is hardly probable from our knowledge of Cuban steamship traffic (which in 1867 was surely not an improvement over the present conditions) that Wright stopped for any length of time at any intermediate station. It is highly probable that the greater part of this time was spent at Trinidad and vicinity covering a period of approximately two months. The amount of material collected at Trinidad may throw some light on this subject, when we know the stations corresponding to Wright's numbers. It is to be hoped that some one who has access to a collection made by Wright which possesses the original localities for the numbers will supplement this paper by further notes which will establish the type localities of Wright's species. Such an account would be a real contribution to our knowledge of the flora of Cuba.

COLUMBIA UNIVERSITY.

The genus Cortinarius: a preliminary study

Calvin Henry Kauffman

Introduction

The genus *Cortinarius*, the largest genus of the *Agaricaceae*, is of special interest because of the small amount of work done on it, especially in this country. Fries in Europe and Peck in America have described nearly all the species so far reported. In recent years, Britzelmayr * has published a number of descriptions of plants found in Bavaria, Germany, where the genus seems to be well represented. That few students study the genus seriously is perhaps due to the fact that it presents certain peculiar difficulties. These, although great enough, are not more than those found in some other parts of the mycological field. Saccardo seems to think that the changing colors deter mycologists from paying more attention to the group. The fading of the colors almost immediately after maturity is certainly a troublesome factor for the beginner, and makes it less easy for him to progress rapidly in their study. For these reasons it is necessary, first of all, to make a thorough acquaintance with the various forms as they occur in their native haunts. By repeatedly collecting the same species in the same localities as well as elsewhere, one should be able at last to distinguish even closely related forms. In this way, the writer has succeeded, as he hopes, in making some small progress towards a better knowledge of the genus.

Three successive summers were spent in collecting material, special attention being paid to the habitat and variabilities of the different species. The same places were visited year after year, and in this way duplicates of the same species from the same spot were frequently obtained. The work was done at Cornell University, Ithaca, N. Y., and the rich collecting grounds in its vicinity afforded abundant material. The fine collection of colored plates of European species found in the botanical laboratory made pos-

* Hymenomyceten aus Südbayern.

sible what progress there was. To Professor G. F. Atkinson, whose enthusiasm in this phase of botany is well known, I owe the inspiration to take up and continue the study.

HISTORICAL

Like many of the generic names of the fleshy fungi, that of *Cortinarius* was bestowed upon it in the time of Persoon and Fries. In the *Synopsis Methodica Fungorum* (1801), Persoon placed "*cortinarius*" as a section under the genus *Agaricus*. Here he included 52 species. Fries, somewhat later (1836–38),* raised the group to generic rank. Saccardo gives him credit for 209 species, including some originally described by Persoon under *Agaricus*. Britzelmayr has described 64. These two men have done most of the work in continental Europe. In North America Professor Peck has described 70 species, nearly all of which belong to the State of New York. The descriptions of these are mostly published in the reports of the regents of the State of New York, beginning with the twenty-third report.

GENERAL CONSIDERATIONS

The genus *Cortinarius* is easily recognized in the field after a season's practice in collecting. The genera most closely allied to it are *Inocybe* and *Hebeloma*, and cases occur where it is at first impossible to decide where the plant in question belongs; but these instances are rather few. *Hebeloma* and *Inocybe*, like *Cortinarius*, grow on the ground. The former is usually separated by the absence of a veil when young, and the gills are paler when mature. *Inocybe* also has paler gills and spores when mature, and is, as a rule, smaller; many of its species are further characterized by cystidia on the gills. Stevenson † says "*Cortinarius* is readily distinguished by its peculiar habit, but is badly defined by artificial characters." This statement is certainly borne out by my experience. It will nevertheless be well at this point to give a brief diagnosis of the genus.

GENERIC DESCRIPTION

Fruit-body fleshy, putrescent, with a veil, this composed of silky threads which in the young plant connect the edge of the

* Epicrisis 255.

† British Fungi.

pileus with the stem. Gills persistent, dry, changing color during the process of maturing, at length powdery with the clinging spores. Trama of pileus and stem fibrillose. Spores, when mature, for the most part cinnamon-brown in mass, subochraceus to rusty-brown by transmitted light. (A more detailed description of the veil must be looked for below.)

The genus was divided by Fries into six *subgenera*. There is hardly a doubt that these will be erected, either wholly or in part, into full genera. Some writers have already done so, but until we know more of the developmental history of the various forms included in these subgenera, it seems to me a rash procedure to multiply genera. The following key, together with a diagnosis of the subgenera, is herewith presented:

Key to Subgenera

A.	Pileus, or both pileus and stem, viscid.	*B.*
	Neither pileus nor stem viscid.	*C.*
B.	Both pileus and stem viscid or glutinous from the universal veil.	*Myxacium.*
	Surface of pileus alone viscid or glutinous.	*Phlegmacium.*
C.	Plant when young covered by a universal veil.	*Telamonia.*
	Plant without a universal veil.	*D.*
D.	Pileus hygrophanous, glabrous; color fading on drying.	*Hydrocybe.*
	Pileus dry, not hygrophanous.	*E.*
E.	Plants large to medium; stem stout, clavate.	*Inoloma.*
	Plants small to medium; stem slender, equal, pileus subsilky.	*Dermocybe.*

MYXACIUM. Pileus fleshy, rather thin. Entire young plant covered by a universal veil which is glutinous and the shreds of which cling to the stem, making it viscous also; on drying, pileus and stem become polished.

PHLEGMACIUM. Pileus fleshy throughout, with a thin gelatinous cuticle which becomes viscid. Stem and cortina dry. No universal veil. Stout plants.

TELAMONIA. Flesh of pileus thin, or somewhat thicker on disk, scissile; pileus hygrophanous, at length covered by white, superficial fibrils, the remains of the universal veil. Entire plant when young covered by the universal veil, which remains on the stem either as partial rings or as a sheath. Partial veil soon disappearing.

HYDROCYBE. No universal veil. Pileus hygrophanous, changing color on drying. Flesh thin, scissile. The partial veil sometimes remaining as an evanescent annulus on the stem.

INOLOMA. Pileus fleshy, rather thick throughout, dry; the scales or fibrils on the surface are not due to a universal veil, but

FIGURE 1. *Cortinarius sterilis* Kauff. Slightly reduced. Spores drawn with camera lucida, magnified about 750 diameters.

are loosened from the tramal tissue beneath; not hygrophanous. Stem stout and fleshy, the base enlarged and tapering upward, *i. e.*, clavate. No universal veil.

DERMOCYBE. Pileus somewhat innately silky like the preceding, but soon glabrous, dry and not hygrophanous. Flesh thin. Stem slender, rather rigid on exterior, equal or attenuated, stuffed or hollow. No universal veil. Partial veil fibrillose. Plants usually bright-colored.

STRUCTURE OF PILEUS AND STEM

There is nothing peculiar in the trama of the pileus of this genus, by which it may be distinguished from related genera. When young, the general description given by de Bary* for *Mycena*, etc., applies to everything but the veils. The hyphæ of the basal part of the young "button" are composed of rather large, oblong cells with air spaces between, these cells becoming smaller and more compact as they approach the apex of the "button," and finally end in the beginnings of the young hymenium as a dense, close-lying mass of deeply staining, minute hyphæ. At least, this is true of *C. squamulosus* Pk. and such others as have been examined. In the mature plant, the trama is largely made up of hyphæ, loosely interwoven, and containing cells, similar to those found in the basal part of the young plant; these hyphæ usually become narrower and longer in the gills, gradually changing to the still narrower subhymenial cells in the manner of many other agarics.

There is one point of interest and importance, however, which has some bearing on taxonomy. This is the cuticle or surface layer of the pileus. In the subgenus *Phlegmacium*, the cells of this layer are long and narrow, lying horizontally parallel or interwoven on the top of the trama; their walls are easily transformed, when sufficient moisture is present, into a gelatinous substance. When a vertical section is made through the surface of the pileus, and this is mounted in water, this layer widens considerably, or it may be pulled out by the razor so as to assume a more or less vertical position. Beneath this layer may be seen a transition group of cells which connect with the ordinary tramal tissue below.

In the subgenera with a dry pileus and no universal veil, the upper layer is composed of narrow, more or less long innate hyphæ, which compose the silky fibrils there met with.

* Fungi, Mycetozoa, and Bacteria 55. 1887.

FIGURE 2. *Cortinarius cylindripes* Kauff.. Reduced one-eleventh. Spores as in Fig. 1.

The tissue of the stem, as one would expect from the conditions of the young "button," is very loosely put together in the mature plant. Further study is needed to determine the exact character in certain of the subgenera. No gelatinous layer is ever present so far as known, its gelatinous character in the subgenus *Myxacium* being due to the remains of the universal veil. The tissue of the stipe is continuous with that of the pileus. The term "fibrillose" is, it seems, the accepted word to described the tramal tissue found in this genus.

CORTINA AND UNIVERSAL VEIL

The genus *Cortinarius* is said to be especially characterized by the silky veil referred to in the diagnosis of the genus. This veil has usually been called "cobwebby" or "arachnoid," because of its peculiar texture. In some of the subgenera, however, there occurs a structure which is not included in the above definition. If for example we take a highly differentiated species, such as *Cortinarius armillatus* Fr., we can observe at the proper stage what might be considered as two veils; the "cobwebby" or inner veil, also called the *cortina*, and an adjacent tissue, the *universal veil.*

The *cortina* is the tissue, composed of loose hyphae, which forms a "cobwebby" curtain in front of, *i. e.*, below the lamellae. The threads of this curtain or *cortina* seem to be inserted for some distance vertically along the stem, and converge in a wedge-shaped manner as they meet the edge of the pileus. In *C. squamulosus* Pk., it clearly coalesces with the trama of the margin of the pileus, and is therefore not superficial in that species. In the young stages of this plant — *e. g.*, when it is only 3 mm. thick — its texture is the same as later, and it seems to fill the cavity under the primordium of the lamellae. Whether this is the typical insertion of a "partial veil" into the pileus must be left an open question till I am able to examine young stages of more species. As the pileus expands and the hymenium matures, the *cortina* gradually disappears. In many cases its remains can be detected at its insertion on the stem, by the fact that the falling spores are caught in its loose meshes and remain as a cinnamon, annular stain on the upper part of the stem. In other cases the margin of the pileus as it spreads, carries with it the shreds of the torn veil in the form of a narrow, silky decoration.

Lying adjacent to the *cortina*, and perhaps continuous with it, on its outer side, is a layer of tissue which envelops the whole plant when young, or at least the part below the margin of the pileus. This is called the *universal veil*. It is apparently not present in all the subgenera of the genus, but when present, as in *C. armillatus* Fr., it is in most cases easily recognized. The universal veil is of somewhat different texture and composition in the different species. In the subgenus *Myxacium* it is glutinous, and gives the glutinous character to the plant. In some of the species of the subgenus *Telamonia*, the hyphae which compose it are so interwoven as to make it extremely tenacious and lasting in character. Where this is the case, it is quite persistent during the later development of the plant, and is represented on the stem as a series of more or less regular bands which encircle it; or, the developing pileus breaks away in such a manner as to leave the part on the stem intact, with a resultant sheath or "stocking" clothing the stem below, in which case the stem is said to be peronate. In others — and this is usually the case in smaller species — the universal veil is quite thin and therefore more evanescent in character. The result is that the remnants of the torn veil soon disappear, or leave such a slight annulus that it is sometimes difficult to determine its existence. The resultant annulus usually occupies a medium or low position on the stem.

It is not quite clear what Fries means when in his generic description he says, "Veil arachnoid, distinct from the cuticle of the pileus, superficial."* He certainly could not have meant the universal veil in the sense in which I have used the term. Then the only interpretation possible, it seems, is to assume that he meant the cortina, which is present in all the subgenera, and that it was considered by him to be continued around the edge and over the surface of the pileus, and, if so, identical to that extent with the universal veil.

It seems that Winter † saw the ambiguity in Fries' description, for he says, "Plant fleshy, putrescent, with a cobwebby veil," with

* Epicrisis 255. 1836.

† Rabenhorst, Kryptogamen Flora, 1: 576. 1883 [2d ed.].

FIGURE 3. *Cortinarius olivaceo-stramineus* Kauff. Natural size. Spores as in Fig. 1.

no mention of its connection with the pileus or of its being superficial to anything. Then in a note he adds, "*Cortinarius* is especially characterized by its velum, which consists of cobwebby threads (hyphæ), and is of a different texture from the cuticle of the pileus. This veil remains after it is finally torn, sometimes on the edge of the pileus, sometimes on the stem, etc. It is here called the cortina." It will probably be found that this cortina is not always continued over the pileus, and hence is not always superficial. The texture of the cortina and that of the surface of the pileus are certainly different in some cases. Whether the cortina is continuous in some cases with a superficial layer of the pileus; whether there is really a superficial cuticle in all the subgenera; or in what cases the cuticle, when present, is continuous with the outer layer of the veil, *i. e.*, the universal veil, must be left until more species can be studied in the young stage.

The writer believes it will aid in clearness of diagnosis of species to use the term "universal veil" for the outer layer of Fries' velum, since this tissue is differentiated to such an extent as to be easily distinguished from the cortina.

As already seen, the universal veil belongs to the subgenera *Myxacium* and *Telamonia*. As to the chances of a universal veil in the subgenus *Phlegmacium*, it may be worth while to call attention to a note by Stevenson,* under *C. turmalis*, in which he considers the scaly covering of a number of plants of the *Phlegmacium* group as the remains of the universal veil. In the subgenus *Telamonia* an important character, besides the universal veil, is said to be the hygrophanous pileus. This has made it rather difficult to place some of our American species which have a dry pileus, but which have a universal veil. Peck placed *C. flavifolius* in *Telamonia* in spite of its dry pileus. It is likely that *C. annulatus* Pk. will be found to belong there when its veil has been thoroughly investigated. A study of *C. squamulosus*, in the very young stage, showed a beautifully differentiated layer of tissue surrounding the young "button," which looks very much like a universal veil. It seems desirable to neglect the hygrophanous character in this subgenus so as to admit the above and similar species. If this is said to conflict with the natural character of the subgenus, it is

* British Fungi **2**: 4.

equally true that placing it among the *Inolomata* defies the natural limits of that subgenus. No other course would then be left but to erect another subgenus, and this is not desirable. Professor Earle, it seems to me, takes the correct view when he separates *Telamonia* from the others on the basis of a universal veil.

GILLS

The *structure* and the *texture* of the gills afford no special help to the student. Britzelmayr,* it is true, considered the method of attachment of the gills to the stem as one of the most valuable characters of the genus, but this does not seem to the writer to be so important. Gillet, in his key, makes considerable use of the serration of the gills; it may be that this can be used to some extent, but it is certainly a very uncertain characteristic.

One of the most helpful characteristics, on the other hand, is *the color of the young gills*. This may be white, olivaceous, violet, blue, red or yellow in the different species, and this character was made use of by Fries to separate the subgenera into further divisions. After the gills attain maturity, these colors are all transformed into some shade of cinnamon. The final appearance of the gills is due to an intermixture of the original color of the gills, and that of the cinnamon-brown spores; this makes it possible at times, even in old specimens, to determine what was the color of the gills in the young plant.

SPORES

The *color* of the young spores is more or less hyaline, or they may be tinged with the same color as the gills. After maturity, the mass always reflects predominantly the cinnamon-brown by which we characterize the genus. Occasionally an ochraceous or yellow tinge prevails, but one can hardly agree with Fries that they are always "subochraceus supra chartam albam." The slight variation in color can hardly be used as a specific character, and Professor Peck no doubt was well aware of this when he refrained from using it in a single description.

The *shape* of the spores is more useful. They may vary all the way from a fairly spherical spore to one whose length is three

* Botanisches Centralblatt **51**: 2.

FIGURE 4. *Cortinarius umidicola* Kauff. About five-sevenths natural size. Spores as in Fig. 1.

times its width. An apiculus, or projection, is usually noticeable and represents the point where the spore is attached to the sterigma.

The spores also vary in the *structure* of the epispore. This is often covered with spiny or tubercular processes; in other cases the spores are quite smooth. In using this as a specific character one must never lose sight of the fact that when young all spores are smooth. It is therefore necessary to make sure that the spores referred to are mature.

The *size* of the spores is, in my opinion, of much greater value for diagnostic purposes, than has hitherto been recognized. There is no doubt that the size of the spores of a single individual varies, and that it varies when there is every evidence that the spores are mature. But that they vary within limits, which are sufficiently constant, any one can determine for himself. One need only take measurements of a great many spores from a number of individuals of an easily recognized species (it is hoped that there are a few such species). One finds, indeed, a certain number of abnormal spores which are larger or smaller than the majority. But these should not be taken into account. It is time that we look more closely into the microscopical characters of these plants, and it is a pleasure to read Mr. Massee's discussion of this point in his recent monograph of the genus *Inocybe*.*

The spores of the genus *Cortinarius* have in all cases examined been found constant within limits. These limits are at times remarkably narrow, at other times just as remarkably wide. For example, a plant which has usually been called *C. alboviolaceus* Fr. in this country, has spores, which at maturity, are from 6.5 to 9.5 μ long, — it is meant by this that the average spores found in the field of the microscope in several mounts, and of as near the mature color as possible, are within these limits. A few may be longer, a number of younger, paler ones are shorter, but spores from this same species always show this same variability. On the other hand, *C. annulatus* Pk. has rather constant spores, somewhat spheroid, 7 μ long by 6.5 μ broad. In this case a single figure is sufficient to denote the length or breadth.

Several species have been studied in prepared sections, in which

* Ann. Bot. 18: 459.

FIGURE 5. *Cortinarius croceocolor* Kauff. Natural size. Spores as in Fig. 1.

binucleate spores are evidently the rule. This, however, is not the place to discuss the matter further.

Of how much value the basidia are as specific characters, has not yet been determined to my satisfaction.

HABITAT

There is little difficulty in getting material for the study of the genus *Cortinarius*, once its haunts are known. One may tramp a whole day through the woods, and hardly find a specimen, even in proper season. As is well known, the genus is eminently *northern* or found in temperate altitudes, and this, with the fact that they occur in the *autumn*, would indicate that they love the cool wood and shady brook. In the region of pine and spruce, or in old beech forests, where the shade is dense and the ground is saturated with moisture — there one may nearly always find spots where they abound. Especially is this the case when the forest covers a hill or ravine along whose slope are found rivulets at intervals of a few yards. Even then one is impressed with the remarkably local character of their occurrence. They need a substratum which is capable of retaining moisture for a considerable time, because they are slower of development than are many others of the fleshy mushrooms. Moisture and the nature of the forest trees seem, as far as at present known, to determine their home. I have collected as many as twenty species within a radius of a few rods. Sometimes a single beech tree is the centre, around which can be found a half dozen or more kinds. Such a case was a swamp of maple, oak and young hemlock, in which a beech tree, standing by itself, was the center of a 15-foot radius, and within the area made by it were found: a troop of 32 specimens of *C. squamulosus* Pk.; also *C. multiformis* Fr., *C. bolaris* Fr., *C. torvus* Fr., and three smaller kinds which were not identified. On entering a new field, a beech forest was invariably a successful collecting ground, when near-by places yielded nothing. So far, our plants were found more often near beech or hemlock. Whether there is some symbiotic relation is an interesting question.

IDENTIFICATION

To make this paper as useful to the beginner as possible, and at the same time further the study of the plants of this interesting

FIGURE 6. *Cortinarius Atkinsonianus* Kauff. Natural size. Spores as in Fig. 1.

genus, it will be necessary to point out a few matters relating to their collection and study. It is sometimes desirable to send away one's specimens for identification, and a lack of certain observations that should have been made in the field may prevent any one from giving them much attention.

It is absolutely useless to pick up an old, dried specimen of *Cortinarius*, and ask any one to recognize it. Once in a while some easily known plant may be recognized in that way, but in the majority of cases old plants of different species look so much alike that it is mere guessing to say anything about them. The first thing to remember is that young, unexpanded plants must be examined as well as mature ones. Next a careful description must be made, *with special reference to the difference in the color of the gills in the young and old plants.* Then a similar comparison of the color of pileus and stem; and then a search for an annulus or universal veil, and its character. Finally a careful test of the pileus and stem for gluten or viscidity. (One must remember that old, dry plants may lose this character.) These points are absolutely essential. In addition to the above, the following characters are often useful: the shape of the pileus; the size of the parts; the smoothness of the surface of pileus and stem; the character of the edge of the gills; the nature of the bulbous base of the stem; the appearance of the flesh. In fact, the notes cannot be too full, *provided they contain the essential facts mentioned first.*

SPECIES

In working over the material, it was found that the chief difficulty lay in the lack of an extensive key to the American species. It is true that Professor Earle * has compiled one from the descriptions of the authors; and although his key sometimes gave me a clue to a species, it also led me astray. This is not so much a reflection on the key — which is admittedly a compilation — it rather shows how unsatisfactory are studies which are made from the descriptions alone. The key which is here presented, although worked out and tested on fresh plants alone, must necessarily have many shortcomings. The possibility of mistaking descriptions of species, especially of European origin, is great. Photographs and

* Torreya 2: 169, 180. 1902.

colored drawings have been made of all the species presented in the key. These, with the dried specimens, have been compared with the type specimens of Professor Peck at Albany, or with European exsiccati in the Cryptogamic Herbarium of Harvard University. The writer here wishes to acknowledge the kindness and courtesy shown him by both Professor Farlow and Professor Peck.

The species included in this key are only such as were found in the vicinity of Ithaca, N. Y., and which could, with a high degree of certainty, be identified. Almost as many more, not included in the key, need further study. It is hoped that the list may not be less useful to students in other localities, even if it is local. Most of the European species included have been reported for New York by Professor Peck.

The natural relationships of the species have been more or less violated in the key, since its maker has had in mind not a final grouping, but a help for beginners.

A PARTIAL KEY TO THE CORTINARII IN THE VICINITY OF ITHACA, N. Y.

A. Pileus with a gelatinous cuticle, more or less viscid or glutinous when moist, as is also the stem in some species. [*Myxacium* and *Phlegmacium*.]

Pileus coarsely corrugate. *C. corrugatus* Pk.

Pileus not corrugate.

Taste of the surface of the pileus extraordinarily bitter; plants small.
C. vibratilis Fr.
C. amarus Pk.

Taste not very bitter.

Spores large, 10 to 16 μ long.

Stem cylindrical and long; entire plant very viscid.

Stem with evanescent scales, or none.
C. cylindripes sp. nov.

Stem with broken, concentric rings of floccose scales.
C. collinitus (Pers.) Fr.

Stem bulbous or short.

Spores 10–12 μ long.

Color very pale yellow with olivaceous tinge.
C. olivaceus-stramineus sp. nov.

Color yellow to orange-ochraceous; no olivaceous tinge.
C. multiformis Fr.

Spores 13–16 μ long; stem violaceous to blue.
C. Atkinsonianus sp. nov.

Spores smaller, 6–9 μ long.

Pileus with dark olivaceous tinge.
C. anfractus Fr.
Pileus with a violaceous or purple color.
Flesh and gills turning purple when bruised.
C. purpurascens Fr.
Flesh not turning purple.
Stem with marginate bulb.
C. caerulescens Fr.
Stem clavate or slightly bulbous. (Pileus sometimes almost pale yellow.)
C. Berlesianus Sacc. & Cub.
Stem subequal ; plants small.
C. croceo-caeruleus (Pers.) Fr.
Pileus some shade of yellow ; no tinge of violet.
Pileus covered by gluten ; stem viscous when moist.
C. sphaerosporus Pk.
Pileus not covered by gluten ; pileus deep tawny-orange ; stem marginate-bulbous.
C. fulgens (Alb. & Schw.) Fr.
Pileus some shade of drab. *C. sterilis* sp. nov.

B. Cuticle of pileus not composed of gelatinous fibers, hence never viscid nor gelatinous. [*Inoloma*, *Telamonia*, *Dermocybe*, and *Hydrocybe*.]
Spores 10–12 μ long ; plants not whitish nor violaceous.
Plants small, 2–4 cm. tall. *C. badius* Pk.
Plants longer, about 8 cm. tall.
Stem with cinnabar-colored, persistent, concentric rings.
C. armillatus (Alb. & Schw.) Fr.
Stem sheathed by the veil, *i. e.*, peronate.
C. torvus Fr.
Spores 4–9 μ long ; if longer, plants are whitish or violaceous.
Stem and pileus scaly or shreddy.
Scales red (scarlet to vermillion). *C. bolaris* (Pers.) Fr.
Scales brown to blackish.
Plant large, watery-spongy, soon dark chocolate-colored.
C. squamulosus Pk.
Plants of medium size, wood-brown.
C. pholideus Fr.
Stem not scaly.
Stem with more or less persistent annular rings or peronate.
Plants large, 1–8 cm. or more tall ; pileus proportionately broad.
Pileus ochraceous, clay-colored, or tawny.
Stem at first peronate by the white universal veil ; pileus at first buff. *C. flavifolius* Pk.
Stem at first peronate by the tawny-yellow universal veil ; pileus at first tawny-yellow.
C. annulatus Pk.
Entire plant saffron-yellow.
C. croceocolor sp. nov.
Pileus bluish to purple when young ; buff to tan when old.

Stem stout, 10–20 mm. thick; pileus punctate.
C. umidicola sp. nov.
Stem more slender, 5–10 mm. thick; pileus not punctate.
C. deceptivus sp. nov.
Plants small, subannulate; pileus less than 3–4 cm. broad.
Pileus watery-cinnamon, smooth.
C. lignarius Pk.
Pileus fuscous, when young covered with white, villose fibrils.
C. paleaceus (Weinm.) Fr.
Stem with no annulus, or annulus evanescent.
Stem bulbous or clavate.
Bulb depressed-marginate; gills heliotrope-purple when young.
C. obliquus Pk.
Bulb clavate.
Color of plant lilac to whitish.
Plants usually larger than in the next; lilac color persistent. *C. lilacinus* Pk.
Plants of medium size; violet tinge evanescent.
C. alboviolaceus (Pers.) Fr.
Color of pileus some shade of buff.
C. caespitosus Pk.
Color of entire plant deep-chrome, unchanging.
C. callisteus Fr.
Stem subequal or tapering downward.
Pileus not hygrophanous.
Pileus cinnamon-colored; stem yellow; no olivaceous tinge.
Gills at first yellow.
C. cinnamomeus (L.) Fr.
Gills at first flame-scarlet.
C. semisanguineus flammeus var. nov.
Gills at first dark blood-red.
C. semisanguineus Fr.
Pileus tawny-olive; stem yellow, olive-tinged.
C. croceus Fr.
Pileus and stem scarlet or blood-red.
Pileus broad as compared with the rather short stem; spores 8 x 5 μ. *C. cinnabarinus* Fr.
Pileus narrower, stem longer; spores 6 x 4 μ.
C. sanguineus (Wulf.) Fr.
Pileus distinctly hygrophanous.
Plant small; pileus 2 cm. broad or less.
Pileus conical at first; stem slender.
C. subflexipes Pk.
Pileus convex at first.
Stem stout, smooth; pileus chestnut-colored.
C. castaneus (Bull.) Fr.
Stem slender, fibrillose; pileus fuscous.
C. fuscoviolaceus Pk.
Pileus broader than 2 cm.

Pileus tawny-orange to cinnamon ; stem pale.
C. armeniacus (Schaeff.) Fr.
Pileus watery-cinnamon ; gills very distant.
C. distans Pk..

Cortinarius sterilis sp. nov.

(*Myxacium*)

Pileus 1.5–4.5 cm. broad, suborbicular when young, then convex-expanded, margin incurved, drab, drab-gray to olive-buff (Ridg.),* even, smooth, *viscid*, somewhat umbonate at times. Flesh white, soft, thin. Gills relatively broad, 4.6 mm., drab-gray (Ridg.) at first, then light cinnamon, rounded behind, then emarginate, not at all ventricose, rather crowded ; edge serratulate and white, later eroded, *provided with sterile cells*. Cortina white or sordid. Stem 4–8 cm. long, 4–6 mm. thick, at base 10 mm., hence clavate or tapering upward, solid, spongy, dingy-white, tinged towards apex with light blue, clothed when fresh with the delicate patches of the *viscid*, universal veil, which is of the same color as the pileus, within pale bluish at apex, white below. Spores 6–7 $\mu \times$ 5–6.5 μ, subspheroid, rather smooth. Plants slender. (FIGURE 1.)

Low places, near sphagnous swamps, near Freeville, N. Y. August 1904, *C. H. Kauffman.*

Cortinarius cylindripes, sp. nov.

(*Myxacium*)

Pileus 3–7 cm. broad, *very glutinous at first* and shining, later opaque, at the very first lavender, then yellowish with a violaceous tinge, at length becoming brownish-ochraceous, with the appearance of being stained by these colors at various stages, obtusely orbicular when young, then campanulate and expanded, rather small in comparison with the length of the stem ; margin incurved and pellucid-striate ; surface smooth, at length longitudinally wrinkled. Flesh thick on disk, thin elsewhere, violaceous, soon dingy-white. Gills rather broad, at length 5–8 mm., adnate, emarginate, not attenuate towards margin of pileus, *violaceous or lavender when young*, becoming pale cinnamon, not crowded, thin, edge serratulate and paler, somewhat wrinkled at the sides but not veined. Stem 8–10 cm. long, 5–9 mm. thick, elastic, *remarkably equal*, covered by a violaceous, *glutinous*, universal veil which sometimes remains as evanescent patches and at its junction with the partial veil as a slight annulus, smooth or fibrillose-striate at

* Ridgeway, Nomenclature of colors.

apex, violaceous to dingy-white within, solid or stuffed; *entire stem usually a beautiful pale azure-blue.* Spores 12–15 $\mu \times 6.5$–$8\ \mu$, slightly tuberculate; basidia about $10\ \mu$ long. (FIGURE 2.)

Gregarious, rarely cespitose. Entire plant is soft and quickly decays. Under hemlock trees, Enfield Gorge, Coy's Glen and Fall Creek Ravine, July to September, 1903–4, *C. H. Kauffman.*

Related to *C. elatior*, from which it differs in its equal stem, which is never scaly and is always violaceous to blue; the gills are lavender when young and the whole plant is very viscous.

Cortinarius olivaceo-stramineus sp. nov.

(*Phlegmacium*)

Pileus 4–7 cm. broad, viscid from a gelatinous cuticle, broadly convex, slightly depressed in the center when expanded, margin incurved for some time, *pale straw-yellow with an olivaceous tinge*, slightly rufous-tinged when old, smooth or silky-fibrillose, disk sometimes covered with minute squamules, shreds of the partial veil attached to the margin when expanded. Flesh *very thick*, becoming abruptly thin towards margin, white, dingy-yellowish in age, *soon soft and spongy.* Gills rather narrow, 7 mm. broad, sinuate-adnexed, whitish at first, then pale cinnamon, crowded, edge serratulate and paler. Stem 6–8 cm. long, 5–12 mm. thick, with a slight bulb when young, from whose margin arises the dense partial veil; white and very pruinate above the veil, which remains as dingy fibrils stained by the spores, spongy and *soft* within, becoming somewhat hollow. Veil white with an olive tinge. Spores 10–12 $\mu \times 5.5$–$6.5\ \mu$, granular within, almost smooth. Odor agreeable. (FIGURE 3.)

To be placed under the division "*scaurus,*" where it comes near *C. herpeticus* Fr., but the gills when young are never violet-tinged.

Near Green-Tree Falls, and Freeville, N. Y., August, 1903, *H. H. Whetzel* and *J. M. Van Hook.*

Cortinarius umidicola sp. nov.

(*Telamonia*)

Pileus as much as 16 cm. broad (generally 6–7 cm. when expanded) hemispherical, then convex and expanded, with the margin for a long time markedly incurved; *young cap heliotrope-purplish* with umber on disk, or somewhat fawn-colored (Ridg.), *fading very quickly to pinkish-buff*, in which condition it is usually found; margin when young with narrow strips, of silky fibrils from the universal veil; pileus when old covered with innate, whitish, silky fibrils, hygrophanous; *surface punctate*, even when young. Flesh of stem and pileus lavender (Ridg.) when young but soon fading to a sordid white, thick on disk, abruptly thin towards margin, soon cavernous from grubs. Gills very broad, as much as 2 cm., *at first lavender*, soon very pale-tan to cinnamon, rather distant, thick, emarginate with a tooth, at first plane then ventricose; edge slightly serratulate, concolorous. Stem as much as 13 cm. long (usually 8 to 10 cm.), 1–2 cm. thick, usually thickened below and tapering slightly upwards, mostly thicker also at apex, rarely attenuate at base, sometimes curved, always *stout*, solid, lavender above the woven, sordid white, universal veil, which at first covers the lower part as a sheath, but soon breaks up so as to leave a band-like annulus half-way or lower down on the stem, or remains on the base of the stem as white fibrillose patches; soon of same color as pileus, hygrophanous, soon cavernous. The annulus is easily rubbed off, leaving a bare stem. Cortina violaceous-white. Spores 7–9 $\mu \times$ 5–6 μ, almost smooth; basidia about 40 μ long. (FIGURE 4.)

Troops of 25 plants were found under a clump of hemlock trees on the edge of a swamp, north of Freeville, N. Y., August 29, 1903, and August 22, 1904, *C. H. Kauffman.*

Cortinarius croceocolor sp. nov.

(*Telamonia*)

Pileus 3–7 cm. broad, convex then expanded, saffron-yellow, with dense, dark brown, erect squamules on disk; whole surface has a velvety appearance and feel, scarcely hygrophanous, even. Flesh of pileus yellowish-white, rather thin except on disk, slightly hygrophanous, scissile. Gills cadmium-yellow (Ridg.), moderately distant, rather thick, emarginate, rather broad, 8–9 mm., width uniform except in front where they taper quickly to a point. Stem 4–8 cm. long, tapering upwards from a thickened base, *i. e.*, *clavate-bulbous*, 9–15 mm. thick below, *peronate three-fourths of its length by the chrome-yellow to saffron veil*, paler above the veil, solid, saffron-colored within, hygrophanous, soon dingy, attached to strands of yellowish mycelium. Spores subspheroid to short-elliptical, 6.5–8 $\times$ 5.5–6.5 μ, echinulate when mature. (FIGURE 5.)

Gregarious or solitary in mixed woods, August 1904, Coy's Glen and Mich. Hollow swamp, Ithaca, N. Y., *C. H. Kauffman.* Entire plant is often saffron-colored.

Cortinarius Atkinsonianus sp. nov.

Pileus 8 cm. broad, expanded, *wax-yellow or gallstone-yellow to clay-colored and tawny* (Ridg.), colors very striking and sometimes several present at once, *viscid*, smooth, even, somewhat shining when dry. Flesh thick, except at margin, bluish-white like the stem, or paler, scarcely or not at all changing when bruised. Gills comparatively narrow, 6–8 mm., width uniform except near outer end, adnate becoming slightly sinuate, *purplish* to yellow, then cinnamon. Stem *violaceous-blue*, 8 cm. long, 12–15 mm. thick, equal or slightly tapering upward, *bulbous* by a rather thick, marginate bulb 3 cm. thick, hung with the fibrillose threads of the universal veil, which is a beautiful pale-yellow and clothes the bulb even at maturity; violaceous-blue within, solid. Spores 13–15 $\mu \times$ 7—8.5 μ, *very tubercular*. (FIGURE 6.)

FIGURE 7. *Cortinarius deceptivus* Kauff. Slightly reduced. Young stages.

The nature of the universal veil indicates its position in the subgenus *Telamonia*, but the viscid cuticle bars it. It needs further study. Only a single, rather mature specimen was found, among hemlocks and poplars, at the base of a sassafras sapling, Enfield Gorge, near Ithaca, N. Y.. September 14, 1903, *C. H. Kauffman.*

Cortinarius deceptivus sp. nov.

(*Telamonia*)

Pileus 1–7 cm. broad, suborbicular to hemispherical, becoming convex-campanulate, *fawn-colored*, tinged with lavender, the lavender tints fading very quickly to pure fawn or light tan, disk alutaceous-buff (Ridg.), covered all over with minute brownish squamules when young, becoming subglabrous, somewhat hygrophanous, rugulose in age. Flesh hygrophanous, pallid with a *strong lavender* tinge when young, which fades out quickly, becoming the color of new cork, thick on disk, thin towards the margin; texture spongy. Gills 3–5 mm. broad, *thick*, moderately close, adnate, emarginate, attenuate at the margin of pileus, *lavender when young*, fading to pale tan when old. Stem rather stout when young, *becoming slender*, 3–6 cm. long, thickened below and tapering upward, *i. e.*, clavate, solid, covered when young by the thick fibrillose universal veil which is *lavender*, fading to white, and remaining as oblique, fugacious, brownish scales or partial rings, these terminate above in the remains of the partial veil which are stained by the spores. Spores 7–9.5 $\mu \times$ 6–7 μ subspheroid to broadly elliptical, rough. The colors and shapes of the plant are very variable and deceptive. Odor not characteristic. (FIGURE 7.)

Common in hemlock woods. Gregarious. On ground and among remains of very rotten logs and brush-heaps, in Coy's Glen, near Ithaca, N. Y., August and September, 1902–1904, *C. H. Kauffman.*

UNIVERSITY OF MICHIGAN.

A Ficus confused with Proteoides

Edward Wilber Berry

(With plate 21)

The genus *Proteoides* was founded in 1866 by Heer to include leaves which he considered as belonging to some member of the *Proteaceae*, but which it was not possible to determine more precisely. Since that date this genus has been the receptacle for those more or less lanceolate, somewhat coriaceous leaves with an obscured venation, which are so common during the latter part of the lower and the first part of the upper Cretaceous. The genus undoubtedly includes some forms whose affinities are with the *Proteaceae*, although I venture to advance the opinion that such an affinity on the part of the American leaves usually referred to this genus is very doubtful.

The species with which I am principally concerned, and with which I am most familiar, is *Proteoides daphnogenoides* Heer, described originally from the Dakota group of Nebraska, and since found to be exceedingly plentiful in the Atlantic coastal plain during the Mid-Cretaceous.

I have for a considerable time been of the opinion that this leaf was not Proteaceous, and this opinion seems to have been at least suggested to Newberry in regard to the Raritan leaves, at least what he says implies that while he is sure that his leaves are identical with those of Heer and Lesquereux from the West, he is doubtful if their specimens were correctly identified. Hollick * is more definite, saying of the Staten Island leaves that they are identical with Newberry's Raritan leaves whether the latter are correctly identified or not.

Without considering any arguments based on the distribution of the *Proteaceae* in the living flora we may note that *Proteoides daphnogenoides*, of the coastal plain, while agreeing exactly with Lesquereux's characterization based on the western forms, even to the

* Hollick, Ann. N. Y. Acad. Sci. 11 : 420. 1898.

very prominent midrib, differs from the existing Proteaceae (*Protea*, etc.) in being less coriaceous, and in the character of the venation, which in the latter is somewhat irregular, with the secondaries springing from the midrib at an acute angle and curving outward instead of upward, and showing a further tendency to be massed from the region of the base, which often lacks a petiole.

The leaves of *Proteoides daphnogenoides* on the other hand, more especially those of Newberry, Hollick, and Berry, are generally larger in size, with an extended and narrowly lanceolate apex, petiolate, and with regular camptodrome secondaries.

Heer's type specimens, which are mere fragments, have some long ascending secondaries but Lesquereux's more complete specimens from the same locality are unquestionably identical with the coastal plain specimens, which latter often show the venation characters. The midrib of all the specimens is fairly stout and very prominent, leaving a deep furrow on impressions; the secondaries are very fine and regular and not readily discernible.

With the idea that these leaves might be referable to the genus *Ficus*, I have examined with considerable care the herbarium material of *Ficus* at the Columbia University herbarium and that of the New York Botanical Garden.

I find numerous points of resemblance, and it may be noted that the produced apex of *Proteoides daphnogenoides* is a character common to a number of species of *Ficus*, where it is even more emphasized. A number of different species from such widely separated localities as Central and South America and the Celebes show points of resemblance to the fossil leaf. Especially among the Mexican and Central American species, do we find very similar forms, *e. g.*: *Ficus sapida* Miq., *Ficus ligustrina* Kunth & Bouché, *Ficus lancifolia* Hook. & Arn., and *Ficus fasciculata* Watson, particularly the first, which has much the same outline and consistency, the same prominent midrib, and the same regularly camptodrome venation.

In turning over the herbarium sheets one is strongly impressed with the conviction that in *Proteoides daphnogenoides* we have another and widespread *Ficus* from the Mid-Cretaceous, which flourished along the ancient coasts of the Atlantic continental mass from Long Island, New Jersey, and Maryland around its then southern border in Alabama, and on the shores across the Mediterranean sea of that period, from Nebraska and Kansas. Lesquereux in 1892 described a large leaf of the same type as a new species of *Ficus* (*i. e.*, *F. proteoides*), thus recognizing its true relations as well as its resemblance to the supposed species of *Proteoides*.

I have not had any opportunity to examine the leaves of this species from Alabama or from the Cheyenne sandstone of Kansas, but as both determinations were by Professor Ward I have no doubt that they are not distinct from the other leaves referred to this species of *Proteoides*.

Placed in the genus *Ficus*, where it seems to me they rightfully belong, these leaves find their affinity in the group which includes, among others, such species as *Ficus elongata* Hosius, *Ficus Berthoudi* Lesq., *Ficus suspecta* Velen., *Ficus Krausiana* Heer, etc.

The accompanying plate will give a good idea of the character of these leaves and includes a nearly complete specimen (FIG. 3) from a new locality (Grove Point, Maryland) recently collected by the writer. It will be noticed that the examples of eastern leaves show the venation much more clearly than do the western specimens.

Following is the synonymy and distribution:

Ficus daphnogenoides (Heer)

Proteoides daphnogenoides Heer, Phyll. Crét. d. Nebr. 17. *pl. 4. f. 9, 10.* 1866.— Lesq. Cret. Fl. 85. *pl. 15. f. 1, 2.* 1874; Fl. Dak. Group 90. 1892.— Hollick, Trans. N. Y. Acad. Sci. **11**: 98. *pl. 3. f. 1, 2.* 1892; **12**: 36. *pl. 2. f. 4, 9, 13.* 1893; Bull. Torrey Club **21**: 52. *pl. 177. f. 1.* 1894; Ann. N. Y. Acad. Sci. **11**: 420. *pl. 36. f. 1–3.* 1898. — Smith, Geol. Coastal Plain of Ala. 348. 1894.— Newberry, Fl. Amboy Clays 72. *pl. 17. f. 8, 9; pl. 32. f. 11, 13, 14; pl. 33. f. 3; pl. 41. f. 15.* 1896.— Gould, Am. Journ. Sci. IV. **5**: 175. 1898. — Berry, Bull. N. Y. Bot. Gard. **3**: 74. *pl. 51. f. 6–9.* 1903.

Ficus proteoides Lesq. Fl. Dak. Group 77. *pl. 12. f. 2.* 1892.

Dakota Group: Nebraska and Kansas.

Raritan formation: New Jersey.

Cretaceous: Staten Island, Long Island, Cliffwood, N. J., and Grove Point, Maryland.

Mill Creek series: Mill Creek, British N. W. Territory.

Tuscaloosa formation: Alabama.

Cheyenne sandstone (Comanche series), Chatman Creek, Kansas.

Explanation of plate 21

(Figures two-thirds natural size)

FIGS. 1, 4. After Lesquereaux, 1874.
FIG. 2. After Hollick, 1894.
FIG. 3. From Grove Point, Maryland.
FIG. 5. Lesquereux's type of *Ficus proteoides*.
FIG. 6. From Cliffwood, N. J.
FIG. 9. After Newb. *pl. 17. f. 9*.
FIGS. 13, 14. After Newb. *pl. 32. f. 13, 14*.

PASSAIC, NEW JERSEY,
February 24, 1905.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1901-1903)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Ball, O. M. Der Einfluss von Zug auf die Ausbildug von Festigungsgewebe. Jahrb. Wiss. Bot. **39**: 305–341. *pl. 6, 7.* 1903.

Britton, N. L. Report on Cuban exploration. Jour. N. Y. Bot. Gard. **4**: 193, 194. N 1903.

Britton, N. L. The rose mallows. Jour. N. Y. Bot. Gard. **4**: 219, 220. *pl. 17, 18.* D 1903.

With description and figure of *Hibiscus oculiroseus* sp. nov.

Brown, E. & Scofield, C. S. Wild rice: its uses and propagation. U. S. Dept. Agr. Plant Ind. Bull. **50**: 1–24. *pl. 1–27.* 28 Au 1903.

Bureau, E. Sur une collection de végétaux fossiles des États-Unis. Bull. Mus. Hist. Nat. Paris **9**: 250, 251. 1903.

Buscalioni, L. Il progetto d'impianto di un Istituto botanico internazionale nell' Amazzonia. Nuovo Giorn. Bot. Ital. II. **9**: 5–32. Ja 1902.

Cockerell, T. D. A. DeVriesian species. Nature **66**: 174. 19 Je 1902.

With descriptions of new varieties in *Helianthus* and *Ribes*.

Cockerell, T. D. A. The fertilization of *Linum*. Nature **66**: 631. 23 O 1902.

Cockerell, T. D. A. An interesting *Yucca.* Nature **69**: 198. 31 D 1903.

Cockerell, T. D. A. Material for natural selection. Nature **66**: 607, 608. 16 O 1902.

Cook, O. F. The culture of the Central American rubber tree. U. S. Dept. Agr. Plant Ind. Bull. **49**: 1–86. *pl. 1–18.* 1 O 1903.

Coulter, J. M. & Chamberlain, C. J. Morphology of angiosperms. (Morphology of spermatophytes, Part II.) i–x. 1–348. *f. 1–113.* New York, 1903.

Coulter, J. M. & Chamberlain, C. J. Morphology of spermatophytes. i–x. 1–188. *f. 1–106.* New York, 1901.

Part I. Gymnosperms.

Coville, F. V. & Wight, W. F. List of plants collected in northern Alaska by W. L. Poto in 1901. Prof. Paper U. S. Geol. Surv. **10**: 58–65. 1902.

Cufino, L. Contributo alla flora briologica del Canadà. Bull. Soc. Bot. Ital. **1903**: 287–290. 1903.

A list of mosses collected in British Columbia by A. Hill in 1902–03.

Cundall, F. An early Jamaica botanist. Bull. Dept. Agric. Jamaica **1**: 155. 1 Jl 1903.

Arthur Broughton (died 1796).

Dominguez, J. A. Datos para la materia medica argentina. **1**: i–xxix. 1–278. Buenos Aires, 1903.

Duss, A. Énumération méthodique des champignons receuillis à la Guadeloupe et à la Martinique. 1–94. Lons-le-Saunier, 1903.

Includes descriptions (by Patouillard) of 42 new species in 36 genera.

Dutailly, G. La staminode des *Parnassia.* Assoc. Franc. Avan. Sci. Compte Rendu **30**^{2}: 457–471. 1902.

Greene, E. L. Distribution of *Bidens vulgata.* Leaflets **1**: 1. 24 N 1903.

Greene, E. L. Further segregates from *Aster.* Leaflets **1**: 4–7. 24 N 1903.

New genera, *Oclemena, Lasallea,* and *Unamia,* with several new species.

Greene, E. L. In the wrong genus. Leaflets **1**: 4. 24 N 1903.

Transfers *Potentilla gracilipes* Piper to *Sieversia.*

Greene, E. L. The logic of it. Leaflets **1**: 14–16. 24 N 1903.

Greene, E. L. Neglected eupatoriaceous genera. Leaflets **1**: 7–13. 24 N 1903.

Kyrstenia Neck., *Traganthes* Wallr., and *Uncasia* gen. nov., with new species.

Greene, E. L. A new southern violet. Leaflets **1**: 2–4. 24 N 1903.

Viola ampliata sp. nov.

Gruber, C. L. *Cratægus* in Berks County [Pa.] II. Compiled from field notes. 1–22. Kutztown, Pa., O 1903.

Gruber, C. L. Hawthorns of Berks County, Pa. I. Compiled from field notes. 1–15. Kutztown, Pa., 1903.

Hemsley, W. B. *Restrepia antennifera.* Curt. Bot. Mag. III. **59**: *pl. 7930.* 1 D 1903.
Native of Columbia.

Herrera, A. L. Sur le rôle prédominant des substances minérales dans les phénomènes biologiques. Bull. Soc. Myc. France **19**: 297–309. 31 Jl 1903.

Holden, R. J. & Harper, R. A. Nuclear divisions and nuclear fusion in *Coleosporium Sonchi-arvensis* Lev. Trans. Wis. Acad. **14**: 63–82. *pl. 1, 2.* S 1903.
Issued in advance of publication of the volume.

Holdt, F. von. Eine dendrologische Fahrt durch die Felsengebirge Colorados. Mitteil. Deuts. Dendr. Gesells. **12**: 110–113. 1903.

Hollick, A. Field work during 1901 in the Cretaceous beds of Long Island. Ann. Rep. N. Y. State Mus. **55**: r48–r51. 1903.
Contains list of fossil plants.

Holm, T. Studies in the *Cyperaceæ;* XIX. The genus *Carex* in Colorado. Am. Jour. Sci. IV. **16**: 17–44. *f. 1–14.* Jl 1903.
Includes descriptions of 3 new species.

Holm, T. Studies in the *Cyperaceæ;* XX. "Greges *Caricum.*" Am. Jour. Sci. IV. **16**: 445–464. D 1903.

Holm, T. *Triadenum virginicum* (L.) Rafin.: a morphological and anatomical study. Am. Journ. Sci. IV. **16**: 369–376. *f. 1–8.* N 1903.

Huntington, A. O. Studies of trees in winter: a description of the deciduous trees of northeastern America. i–xviii. 1–198. Boston, D 1901. [Illust.]

Jadin, F. Essai de classification des Simarubacées basée sur les caractères anatomiques. Assoc. Franc. Avanc. Sci. Compte Rendu **30**²: 477–483. 1902.

Koehne, E. Die Sektion *Microcarpium* der Gattung *Cornus.* Mitteil. Deuts. Dendr. Gesells. **12**: 27–50. 1903.

Kunzé, R. E. Ueber *Cereus Thurberi* Eng. Monats. Kakteenk. **13**: 172. 15 N 1903.

Langille, H. D. Forest conditions in the Cascade Range forest reserve, Oregon. Prof. Paper U. S. Geol. Sur. **9**: 1–298. *pl. 1–41.* 1903.

Leiberg, J. B. Forest conditions in the northern Sierra Nevada, California. Prof. Paper U. S. Geol. Surv. **8**: 1–194. *pl. 1–12.* 1902.

Léveillé, H. & Guffroy, C. Monographie du genre *Onothera.* 1–138 Le Mans, [31 Jl] 1902. [Illust.]

This fascicle includes three of the five sections into which the authors divide the genus, with four new species.

Lloyd, C. G. Mycological notes. 15: 149–156. 25 My 1903.

Lloyd, F. E. Report of a botanical expedition to the island of Dominica, B. W. I. Journ. N. Y. Bot. Gard. **4**: 194–205. *f. 22–25.* N 1903.

MacDougal, D. T. Soil temperatures and vegetation. U. S. Mo. Weather Rev. **31**: 375–379. *f. 1–7.* 23 O 1903.

Mayr, H. Kleinere Mitteilungen über Coniferen. Mitteil. Deuts. Dendr. Gesells. **10**: 56–58. 1901.

Including a discussion of the species of *Pseudotsuga.*

Merrill, E. D. A dictionary of the plant names of the Philippine Islands. 1–193. Manila, 1903.

Bureau Gov. Lab. 1903.—No. 8.

Nash, G. V. Report of exploration of Hayti. Journ. N. Y. Bot. Gard. **4**: 205–215. *f. 26–29.* N 1903.

Noelli, A. Revisione delle forme del genere *Steganosporium* Corda. Malpighia **17**: 412–418. *f. 1–6.* 1903.

Paul, D. On the ferns, especially the filmy ferns, of Jamaica. Trans. Bot. Soc. Edinb. **22**: 1–12. 1901.

Peckolt, T. Medicinal plants of Brazil. Pharm. Rev. **20**: 51–54. F 1902; 110–112. Mr 1902; 492–497. N 1902.

Penzig, O. & Chiabrera, C. Contributo alla conoscenza delle piante acarofile. Malpighia **17**: 429–487. *pl. 16–18.* 1903.

Plummer, F. G. Forest conditions in the Cascade Range, Washington, between the Washington and Mount Ranier forest reserves. Prof. Paper U. S. Geol. Surv. **6**: 1–42. *pl. 1–11.* 1902.

Rehder, A. Einige neuere oder kritische Gehölze. Mitteil. Deuts. Dendr. Gesells. **12**: 115–126. 1903.

Rehder, A. Einige neuere und wenig bekannte Gehölze. Mitteil. Deuts. Dendr. Gesells. **10**: 111–117. 1901.

Reiche, C. La isla de La Mocha. 1–107. *pl. 1–12.* Santiago de Chile, 1903.

Anal. Mus. Nac. Chile, No. 16. A monograph of the island, chapters 12 to 14, pages 64–104, being devoted to botany.

Reinke, J. Studien zur vergleichenden Entwickelungsgeschichte der Laminariaceen. 1–67. Kiel, 1903.

Revedin, P. Studio sopra i peli delle borraginacee. Nuovo Giorn. Bot. Ital. II. **9**: 301–318. *f. 1–44.* Jl 1902.

Rowe, J. P. Some volcanic ash beds of Montana. Bull. Univ. Mont. **17**: 1–32. *pl. 1–9.* 1903.

Leaves from ash in Missoula County are listed on pages 21 and 22, and figured on *pl. 6–8.*

Saint-Paul, U. von. *Pseudotsuga Douglasii* Carrière. Mitteil. Deuts. Dendr. Gesells. **10**: 1–8. 1901.

Sargent, C. S. Trees and shrubs; illustrations of new or little known ligneous plants. (Part III.) **1**: 101–150. *pl. 51–75.* Boston, 14 N 1903.

Includes new species in *Crataegus* (6), *Euonymus*, *Viburnum*, *Grypocarpha* Greenm. (gen. nov.), and *Pinus*.

Schumann, K. Blühende Kakteen (Iconographia *Cactacearum*). **3**: *pl. 9–12.* [22 Mr 1901]; **4**: *pl. 13–16.* [30 Jl 1901]; **5**: *pl. 17–20.* [29 N 1901]; **6**: *pl. 21–24.* [25 Mr 1902]; **7**: *pl. 25–28.* [31 Jl 1902]; **8**: *pl. 29–32.* [14 N 1902]; **9**: *pl. 33–36.* [19 F 1903]; **10**: *pl. 37–40.* [10 Je 1903]; **11**: *pl. 41–44.* [22 Au 1903]; **12**: *pl. 45–48.* [10 D 1903.]

Plate 44 illustrates *Opuntia Mieckleyi* sp. nov., from Paraguay.

Schumann, K. *Echinopsis albispinosa* K. Sch. n. sp. Monats. Kakteenk. **13**: 154, 155. 15 O 1903. [Illust.]

Native of South America.

Schumann, K. Neue und wenig gekannte Kakteen von den Anden Süd-Amerikas. II. Monats. Kakteenk. **13**: 167–171. 15 N 1903. [Illust.]

Pilocereus macrostibas sp. nov., from Peru.

Schumann, K. Ein neuer *Echinocactus* aus Südbrasilien. Monats. Kakteenk. **13**: 129, 130. 15 S 1903.

E. Graessneri sp. nov.

Scofield, C. S. The description of wheat varieties. U. S. Dept. Agr. Plant Ind. Bull. **47**: 1–19. *pl. 1–7.* 18 Au 1903.

Scudder, S. H. and Cockerell, T. D. A. A first list of the *Orthoptera* of New Mexico. Proc. Davenport Acad. Sci. **9**: 1–60. *pl. 1–4.* 1902.

The introductory remarks by T. D. A. Cockerell include many references to characteristic plants of various localities in New Mexico.

Sellards, E. H. *Codonotheca*, a new type of spore-bearing organ from the Coal Measures. Am. Jour. Sci. IV. **16**: 87–95. *pl. 8* + *f.* Jl 1903.

Snow, C. H. The principal species of wood: their characteristic properties. i–xvi. 1–203. *pl. 1–39.* New York, 1903.

Spillman, W. J. Mendel's Law. Pop. Sci. Mo. **62**: 269–280. Ja 1903.

Timberlake, H. G. Development and structure of the swarm-spores of *Hydrodictyon.* Trans. Wis. Acad. **13**: 486–522. *pl. 29, 30.* 1902.

Trotter, A. Descrizioni di alcune galle dell' America del Sud. Bull. Soc. Bot. Ital. **1902**: 28–107. 1902.

Ule, E. Das Uebergangsgebeit der *Hylaea* zu den Anden. Bot. Jahr. Beibl. **73**: 74–78. 4 D 1903.

Urban, I. Flora portoricensis. Symb. Antill. **4**: 1–192. 16 S 1903.

New species are described in *Aristida*, *Eragrostis*, *Arthrostylidium*, *Inodes*, *Philodendron*, *Costus*, *Campylocentrum*, and *Peperomia*.

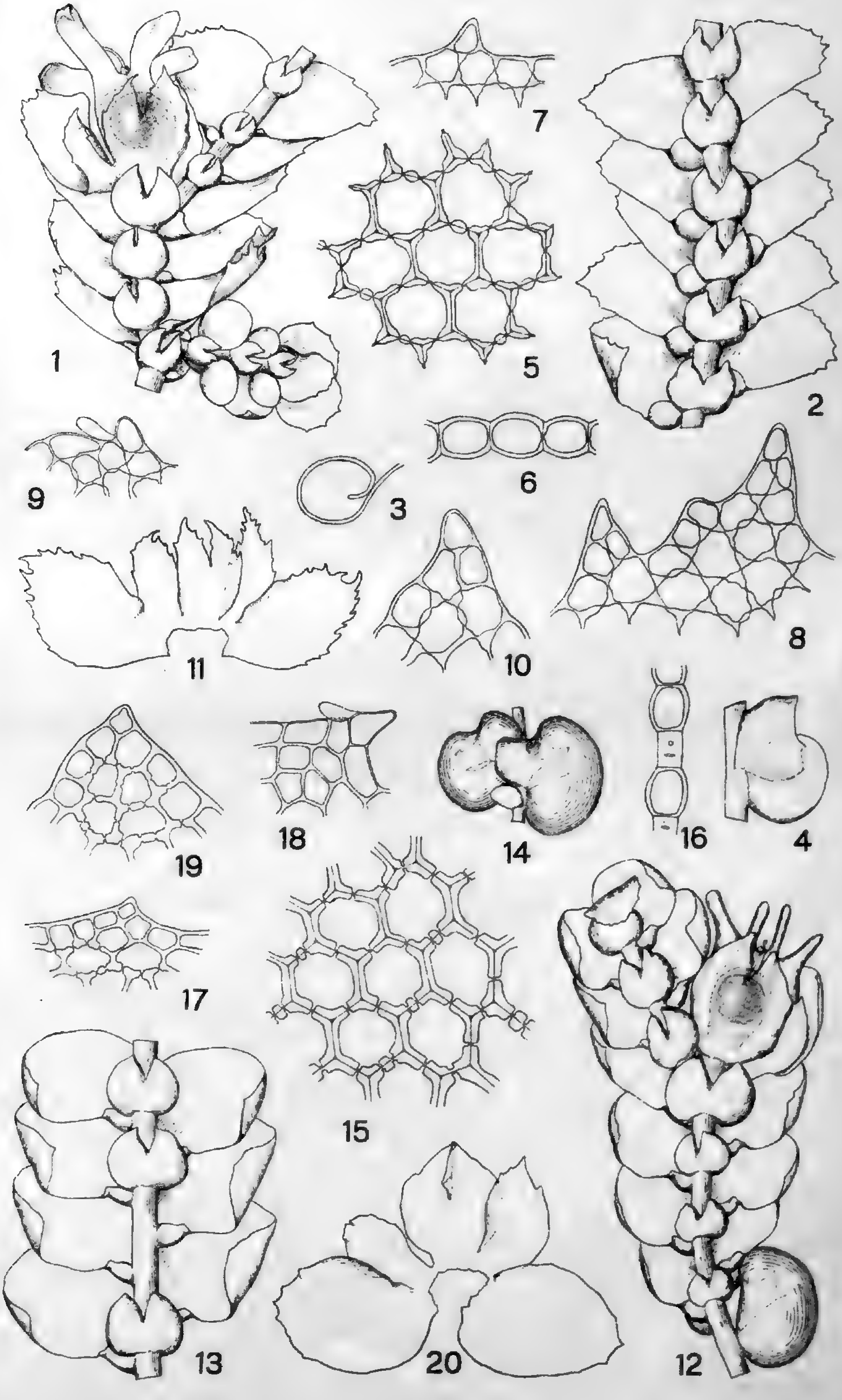
Urban, I. Ueber die botanische Erforschung Westindiens in den letzten Jahrzehnten. Bot. Jahrb. Beibl. **73**: 28–32. 4 D 1903.

Van Tieghem, P. Structure et affinités des Erythroxylacées: un nouvelle exemple de cristarque. Bull. Mus. Hist. Nat. Paris **9**: 287–295. 1903.

Van Tieghem, P. Sur les Columelliacées. Bull. Mus. Hist. Nat. Paris **9**: 233–239. 1903.

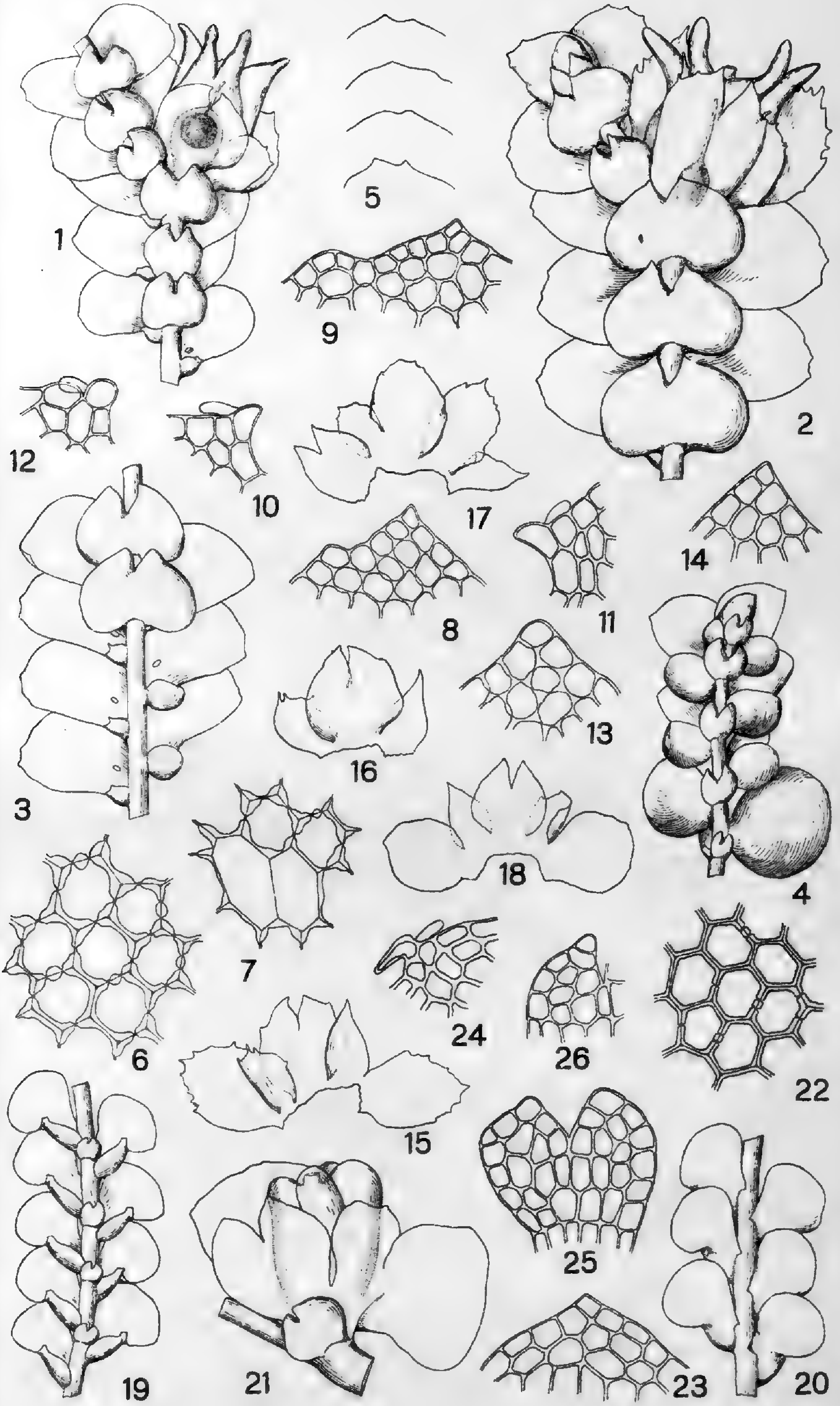
White, C. A. Varietal mutation in the tomato. Science II. **14**: 841–844. 29 N 1901.

Woods, A. F. Autumnal coloration of foliage. U. S. Mo. Weather Rev. **31**: 270, 271. 17 Au 1903.



1-11. CERATOLEJEUNEA SPINOSA (Gottsche) Steph.

12-20. CERATOLEJEUNEA VALIDA Evans.



1-18. CERATOLEJEUNEA SCHWANECKEI Steph.

19-26. CERATOLEJEUNEA PATENTISSIMA (Hampe & Gottsche) Evans.

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JULY, 1905

Stimulation of Sterigmatocystis by chloroform

Marion Elizabeth Latham

The response of fungi to the influence of salts and other chemical compounds, as manifested by accelerated growth, increased weight, and active evolution of carbon dioxide, has been the subject of several investigations within a recent period. Raulin's * early observations have been much extended by Richards † who has ascribed ‡ the action to a more economical use of the nutrition at hand, that is, he has proved the economic coefficient of Kunstmann § to decrease as the stimulant approaches its point of optimum efficacy. Ono, || Yashuda,¶ Hattori, ** Stevens,†† Iwanoff,‡‡ Benecke§§ and others have extended the range of

* Raulin, J. Études chimiques sur la vegetation. Ann. Sc. Nat. Bot. V. 11: 93. 1869.

† Richards, H. M. Die Beeinflussung des Wachsthums einiger Pilze durch chemische Reize. Jahrb. Wiss. Bot. 30: 665. 1897.

‡ Richards, H. M. The effect of chemical irritation on the economic coefficient of sugar. Bull. Torrey Club 26: 463. 1899.

§ Kunstmann, H. Ueber das Verhältniss z. Pilzernte u. verbrauchter Nährung. Inaug. Dissert. Leipzig, 1895.

|| Ono, N. Ueber die Wachsthumsbeschleunigung einiger Algen u. Pilze. Jour. Coll. Sci. Imp. Univ. Tokyo 13: 141. 1900.

¶ Yashuda, A. On the effect of alkaloids upon some moulds. Bot. Mag. Tokyo 15. 1901.

** Hattori, H. Studien über die Einwirkung der Kupfersulfats auf einige Pflanzen. Jour. Coll. Sci. Imp. Tokyo 15: 371. 1901.

†† Stevens, F. L. The effect of aqueous solutions upon the germination of fungus spores. Bot. Gaz. 26: 377. 1898.

‡‡ Iwanoff, K. S. Ueber die Wirkung einiger Metallsalze und einatomiger Alkohole auf die Entwickelung von Schimmelpilzen. Bot. Centralb. 98: 97. 1905.

§§ Benecke, W. Die zur Ernährung der Schimmelpilze nothwendigen Metalle. Jahrb. Wiss. Bot. 28: 487. 1895; and Einige neuere Untersuchungen über den Einfluss von Mineralsalzen auf Organismen. Bot. Zeit. 62²: 113. 1904.

[The Bulletin for June (32: 273–336. *pl. 19–21*) was issued 30 Je 1905.]

toxic compounds, all with concordant results; namely, that those substances which in larger amounts are fatal, serve to stimulate the organism to increase in activity when present in sufficiently small quantities, in accordance with the generalization of Hueppe.* In addition, Ono † has found that the waste through oxalic acid formation is at the same time lessened; and Watterson ‡ that although there is greater expiration of CO_2 the increase is only parallel with that of the crop and its production relatively normal. Schulz § working with yeast; Hueppe,‖ Effront,¶ and Lindet ** with bacteria; and Ono †† and Livingston ‡‡ with algae have reached like conclusions as far as growth is concerned.

Copeland and Kahlenberg,‖‖ and Kahlenberg and True,*** and more lately Kanda,††† working with higher plants tell of stimulation caused by salts. Similarly Copeland ‡‡‡ has obtained increased CO_2 evolution from work with phanerogams and tadpoles, interpretating the apparent vigor, however, as an evidence of harm rather than benefit.

Townsend §§§ mixed ether with water supplied to seeds and thus hastened germination. He has also shown that seeds, subjected to HCN gas ‖‖‖ for a short time, sprout sooner and grow

* Hueppe, F. The Principles of Bacteriology, 89, 90. Trans. by E. O. Jordan.

† *L. c.*

‡ Watterson, A. The effect of chemical irritation on the respiration of fungi. Bull. Torrey Club **31**: 291. 1904.

§ Schulz. Ueber Hefegifte. Bot. Zeit. **46**: 610. 1888.

‖ *L. c.*

¶ Effront. Compt. rend. **119**: 169. 1894.

** Lindet. Compt. rend. **138**: 508. 1904.

†† *L. c.*

‡‡ Livingston, B. E. Chemical stimulation of a green alga. Bull. Torrey Club **32**: 1. 1905.

‖‖ Copeland, E. B. & Kahlenberg, L. The influence of the presence of pure metals upon plants. Trans. Wis. Acad. **12**: 454. 1899.

*** Kahlenberg, L. & True, R. H. On the toxic action of dissolved salts. Bot. Gaz. **22**: 81. 1896.

††† Kanda, M. Reizwirkung einiger Metallsalze auf das Wachsthum höherere Pflanzen. Jour. Coll. Sci. Imp. Tokyo **19**: 1. 1904.

‡‡‡ Copeland, E. B. Chemical stimulation and the evolution of CO_2. Bot. Gaz. **35**: 81. 1903.

§§§ Townsend, C. O. The effect of hydrocyanic acid gas upon grains and other seeds. Bot. Gaz. **31**: 241. 1901.

‖‖‖ Townsend, C. O. The correlation of growth under the influence of injuries. Ann. Bot. **11**: 509. 1897.

more rapidly than those not so treated; that *Avena* seedlings grown in a sufficiently weak atmosphere of ether are at first retarded and then accelerated, finally returning to their normal rate of growth if the shock be not too long continued; and that in small amounts ether vapor will aid germination in the spores of *Penicillium* and *Mucor*,* although larger doses are inimical. Duggar † says that a saturated atmosphere of chloroform is fatal to the spores of *Aspergillus flavus* and *Phycomyces* and without benefit to *Sterigmatocystis*, and that ether is of no consequence as a stimulant in germinating *Aspergillus*. With *Aspergillus* (*Sterigmatocystis*) *niger*, Kosinski ‡ finds respiration retarded when exposed to ether fumes.

Ewart, § working with chloroform in the water of water plants noted suspension of CO_2 assimilation agreeing with the earlier results of Claude Bernard. Kegel, || however, finds with *Elodea canadensis* an increment of CO_2 assimilation in some percentages of ether and chloroform, but a sudden check in the case of a lesser amount. On the other hand, Bonnier and Mangin ¶ were able, by adding ether carefully, to stop assimilation of CO_2 without affecting respiration, an observation in accordance with that of Schwarz,** who, with both ether and chloroform, has recorded stoppage of oxygen evolution not accompanied by elimination of CO_2 evolution until the plant was fatally affected. Ewart's †† results with mosses were similar. Movement in the protoplasm of *Philotria* (*Elodea*),

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* Townsend, C. O. Effect of ether upon the germination of seeds and spores. Bot. Gaz. 27: 458. 1899.

† Duggar, B. M. Physiological studies with reference to the germination of certain fungous spores. Bot. Gaz. 31: 38. 1901.

‡ Kosinski, I. Die Athmung bei Hungerzuständen u. unter Einwirkung von mechanischen u. chemischen Reizmitteln bei Aspergillus niger. Jahrb. Wiss. Bot. 37: 137. 1902.

§ Ewart, A. J. Action of chloroform on CO_2 assimilation. Ann. Bot. 12: 415. 1898.

|| Kegel, W. Ueber den Einfluss von Chloroform und Aether auf die Assimilation von Elodea canadensis. Inaug. Dissert. Göttingen, 1905.

¶ Bonnier, G. & Mangin, L. Recherches sur l' action chlorophyllienne séparée de la respiration. Ann. Sci. Nat. VII. 3: 5. 1886.

** Schwarz, F. Zur Kritik der Methode des Gasblasenzählens an submersen Wasserpflanzen. Untersuch. Bot. Inst. zu Tübingen, 1: 97. 1881.

†† Ewart, A. J. On assimilatory inhibition in chlorophyllous plants. Jour. Linn. Soc. 31: 364. 1896.

as seen by Farmer and Waller,* ceased under the influence of ether and chloroform, the latter proving more powerful.

With various seedlings in an ether atmosphere, Morkowine † obtained increase of respiration in the light; Bonnier and Mangin ‡ got no such effect in the dark. Puriewitsch, as quoted by Morkowine,§ concluded that in ether vapor, transformation of sugar to starch is inhibited. Jumelle ‖ believes transpiration increased in light and decreased in dark by ether, Zaleski ¶ that proteid formation is hindered by the same substance. Pfeffer ** cites Elfving †† and Laurén ‡‡ as authorities for the observation that CO_2 formation, but not growth, is augmented in higher plants by a not too long exposure to chloroform; and finally, Johanssen §§ has proved the economic value of ether in forcing early blooming in flowering plants. The period of winter rest is shortened, rapidity of growth and total evolution of CO_2 increased.

The majority of the investigations with chloroform and ether, it will be noted, have had to do with their effect on green plants. Townsend ‖‖ and Duggar ¶¶ to be sure, experimented with fungus spores but their work stopped with germination; and Kosinski *** was concerned only with the respiration factor. It has been the aim of the piece of work here described to compare the effect of chloroform vapor on fungus growth, as shown by increase in dry substance, with the results quoted above. Therefore *Sterigmatocystis nigra* (*Aspergillus niger*) in the main and *Penicillium glaucum*

* Farmer, J. B. & Waller, A. D. Observations on the action of anaesthetics on vegetable and animal protoplasm. Proc. Royal Soc. **63**: 213. 1898.

† Morkowine, N. Recherches sur l' influence des anesthésiques sur la respiration des plantes. Rev. Gen. de Bot. **11**: 289. 1899.

‡ Bonnier & Mangin, *l. c.*

§ *L. c.*

‖ Jumelle, H. Influence des anesthésiques sur la transpiration des végétaux. Rev. Gen. de Bot. **2**: 417. 1890.

¶ Zaleski, W. Zur Aetherwirkung auf die Stoffumwandlung in den Pflanzen. Ber. Deuts. Bot. Gesells. **18**: 292. 1900.

** Pfeffer. Physiology of Plants, **1**: 564. Trans. by Ewart.

†† Elfving. Ueber die Einwirkung von Aether u. Chloroform auf die Pflanzen. Oefversigt af Finska Vetensk. Soc. Forh. **28**: 36. 1886.

‡‡ Laurén. Bot. Jahresb. **20**[1]: 92. 1892.

§§ Johanssen, W. L. Das Aether-Verfahren beim Frühtreiben. Jena. 1900.

‖‖ Bot. Gaz. *l. c.*

¶¶ *L. c.*

*** *L. c.*

to a lesser extent were grown on the nutrient solutions prescribed by Pfeffer * and designated as A and C in the first paper on the subject by Richards,† the cultures confined in an atmosphere of chloroform of known or approximately known value and the effect upon dry weight of the crop, economic coefficient and acid coefficient noted.

The work was done in the botanical laboratory of Barnard College during the years 1904 and 1905 under the guidance of Dr. Herbert Maule Richards, to whom his student is much indebted for his kindness and interest. To the New York Botanical Garden many thanks are due for extending the privileges of the library.

To grow the fungi, small dishes 70 mm. in diameter and 30 mm. deep were used. These, in all series following IV, were of the non-sol glass of Whitall, Tatum & Co. Each culture dish rested on two strips of glass over a half Petri dish containing 40 c.c. of a 10 per cent. KOH solution. The Petri dish in turn sat upon a ground-glass plate. On glass strips laid across the culture dish was supported a small watch glass to receive the chloroform. In operating, each dish was arranged as described and all covered by a bell-jar which was ground down on to the glass plate in a glycerine-gelatine seal. After the seal had hardened, amounts of chloroform calculated to the capacity of the jars — due allowance having been made for the solids and liquids within — were run in through the neck which was at once closed with a rubber stopper. It is possible in this way to regulate the supply of chloroform vapor with tolerable accuracy, for the placing of the stopper in position occupies but a moment and relatively little of the chloroform can volatilize and escape. Moreover, the seal at the base of the jar is sufficiently strong to be proof against any small pressure generated by the vaporizing liquid.

In manipulation, the usual precautions were observed. The culture dishes, before each using, were soaked in dichromate cleaning solution, washed, rinsed in distilled and redistilled water and sterilized in hot air at 100°–120° C. The bell-jars were

* Pfeffer, W. Ueber Election organischer Nährstoffe. Jahrb. Wiss. Bot. **28**: 205. 1895.

† *L. c.*

rinsed in formalin; the glass strips and watch glasses were washed and sterilized in hot air (100°–120° C.). All flasks and pipettes were handled similarly.

The redistilled water mentioned above was the distilled water furnished for ordinary laboratory purposes in the college — the still is tin-lined — redistilled and condensed through a block-tin tube. A considerable portion passing over at first was discarded and the operation stopped while a quantity remained in the distilling flask. This water was used in making all solutions, as well as for the final rinsings of the apparatus. Its specific conductivity as determined in the physics laboratory varied between 2.74×10^{-6} and 1.59×10^{-6}. The salts used were the best quality supplied by Merck & Co. White rock-candy furnished the sugar. A solution of 30–50 per cent. was made, filtered through glass wool to remove the bits of string and kept tightly corked for use. The proper amount from the stock was taken for each solution made for a series. Iron, also, was kept in solution, but the other salts were weighed out as required. The formulae of the solutions are as follows:

A		C	
NH_4NO_3	1.00 gm.	Asparagine	0.50 gm.
K_2HPO_4	0.50 gm.	KH_2PO_4	0.50 gm.
$MgSO_4$	0.25 gm.	$MgSO_4$	0.25 gm.
$FeSO_4$	trace.	$FeSO_4$	trace.
Sugar	5.00 gm.	Sugar	5.00 gm.
Water	100.00 c.c.	Water	100.00 c.c.

The chloroform was the best grade made by Merck, known to contain .02 per cent. of absolute alcohol to prevent decomposition, which, however, in the quantities of the anaesthetic used is negligible. Repeated tests with $AgNO_3$ showed that no free Cl was present.

Sowing the fungus was accomplished by dipping the end of a clean glass rod into the nutrient solution, rubbing it over the dry spores, redipping it into the fluid, and agitating well to secure uniform distribution. The smooth white felts of the control cultures testified to the effectiveness of the treatment and the purity of the reagents. In practice, enough nutrient solution was made at a time for one complete series — the iron alone omitted. This solution was boiled, cooled and 50 c.c. taken in an accurate pipette to be analyzed for acid and sugar. The remainder was then inoculated in bulk with spores in the method described and doses of 50 c.c. run from the pipette into each culture dish. Last of all the iron, a mere trace, was added.

The crop was reaped when the controls showed a full fruited surface. The felts were thrown on weighed filters, washed thoroughly with boiling water, dried in hot air at 70°–80° C., cooled in a desiccator and the dry weight ascertained. The filtrate made up to 250 c.c. was analyzed, as recorded, for oxalic acid, or sugar, or both. Determinations for oxalic acid in the filtrate from the *Sterigmatocystis* * were made at once. Ten cubic centimeters of the solution were titrated against standardized NaOH. The total acidity, less the acidity at the time of setting up (that of the stock solution), gave the correct amount of acid produced during growth.

A measured quantity of the filtrate, generally 100 c.c., was next inverted by boiling with 0.5 c.c. of 5N HCl and the invert sugar estimated by the Fehling test. When asparagine was present, extra care was taken. A cubic centimeter or 1.5 c.c. of acid was used for inversion and the time of boiling extended, water being added if necessary. Asparagine, by virtue of its amide groups, will reduce a copper solution and invalidate a test for sugar in its presence. Hard boiling with HCl serves to destroy the molecule with the production of NH_4Cl, which does not interfere with the analysis. The Fehling solution was kept in two portions. The stock $CuSO_4$ contained 69.28 gms. per liter; the alkaline tartrate, 100 gms. of NaOH and 350 gms. of $KNaC_4H_4O_6$ per liter. Standardization was made against accurately freshly prepared 1 per cent. dextrose. For each analysis 5 c.c. of each stock solution and 40 c.c. of H_2O were used. Calculations were made on the basis that under such conditions 0.5 gm. of invert sugar reduces 97 c.c. of the Fehling solution.†

The fruiting of the control cultures, as mentioned, determined the reaping of the crop. The period of growth varied with the temperature. Near its optimum of 34° C., *Sterigmatocystis* was

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* Wehmer. Entstehung und physiologische Bedeutung der Oxalsäure im Stoffwechsel einiger Pilze. Bot. Zeit. 49: 1891.

† Sutton. Volumetric Analysis. Ed. 1904.

ready to harvest in seven to ten days when grown on solution A, or in four to five days when asparagine replaced the NH_4NO_3; while the period of cultivation extended over two to three weeks if the temperature fell to 20°–25° C. The lack of constant conditions is to be regretted, especially in view of indications which may be discussed later.

The first effect of $CHCl_3$ used in such an amount as is necessary to cause noticeable stimulation is to retard the germination of the spores. With the smallest quantities employed, the first hyphae did not appear until six to twenty-four hours after growth had started in the chloroform-free air. The second effect seen is the production of toughened, buckled felts by a rapid growth accompanied by repression of conidial fructification, as observed also when the organism is stimulated by salts, etc. At harvesting, felts grown under optimum stimulation gave on an average crops 200 per cent. to 300 per cent. as heavy as the normal, rising in some instances to 500 per cent. and 700 per cent. The curve representing the influence of $CHCl_3$ on growth is similar to those of other stimulants; it rises in a characteristic manner to a maximum and then falls again.

Sterigmatocystis cultivated on solution A at a temperature varying between 20° and 30° C. grows more luxuriantly when the content of the atmosphere is, per liter, the vapor of $\frac{1}{3}$ c.c. of liquid $CHCl_3$ and the beneficial effect increases until $\frac{1}{2}$–$\frac{7}{12}$ c.c. per liter are used, when decrease begins. If the bell-jar contains per liter over 1 c.c. of $CHCl_3$ (vaporized), germination is permanently stopped, although the spores will grow readily if placed in air. When asparagine, instead of NH_4NO_3, is the source of nitrogen (solution C) the sensitivity of the *Sterigmatocystis* is increased. Optimum growth then takes place when $\frac{1}{6}$–$\frac{1}{4}$ c.c. of $CHCl_3$ is present per liter, and $\frac{2}{3}$ c.c. is sufficient to arrest development.

The augmentation in weight is accompanied by a relatively lessened acid formation and sugar consumption; that is to say, the ratio of the acid to the crop, and of the sugar used to the crop is lowered. For example, in Series X, Table I, the acid coefficient is lowered from 2.3186 to .4160 grams per gram fungus when the atmosphere held $\frac{1}{2}$ c.c. of $CHCl_3$ vaporized and to .3551 grams per gram fungus when the content was $\frac{7}{12}$ c.c.; at the same time, the economic coefficient fell from 11.493 to 3.214 and 3.201 grams per gram fungus respectively. The average figures for the atmospheres quoted are for acid coefficient 0.6932 and 0.5696 and for sugar 3.744 and 3.514 against 1.4123 and 5.358 for the normal culture. The economic coefficient of the controls varies considerably from that found by Kunstmann * and Richards,† to be sure, but the figures obtained are fairly stable. The same thing is true of the data for oxalic acid as compared with those of Ono.‡ That irregular fluctuations may be regarded as due to individual peculiarities is indicated by the consistency in the various factors. For instance, a lack of due increase in weight is, in general, accompanied by an abnormal rise in the coefficients of acid and sugar, pointing to internal differences rather than to errors in calculation or manipulation.

Chloroform belongs to the so-called catalytics in Loew's § classification. The small amount absorbed by the water of the nutrient solution affects the protoplasm so as to cause it to work more economically, possibly through action on the enzyme formed.|| However that may be, the figures point again to the explanation of the phenomena advanced by Richards¶ and by Ono** as his third alternative, *i. e.*, that the fungus can under the conditions produced by the stimulant thrive more economically.

The sensitivity of *Penicillium* on solution A is about equal to that of *Sterigmatocystis* on solution C.

Another question of interest is the stage in the growth at which the $CHCl_3$ is most potent. To learn this, series were run with the optimum of $CHCl_3$ placed in some when set up as before and in others after the spores had been allowed to start. The former were more prosperous (Table III); that is, the impulse given at germination is more effective than one applied later, but even after complete germination, the fungus responds, although in a lesser degree, in the characteristic fashion.

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* *L. c.*

† *L. c.*

‡ *L. c.*

§ Loew. "Naturliche System der Gift Wirkungen." Munich, 1893, as quoted by Davenport, Experimental Morphology, p. 7.

|| Hueppe (*l. c.*) suggests this vaguely.

¶ *L. c.*

** *L. c.*

That chloroform cannot furnish carbon was settled by sowing spores on a solution of the necessary salts, but omitting sugar, and then placing in optimum chloroform conditions. Not a sign of a germ tube appeared even after two weeks' time.

Although there are no direct data on this point at present, still it is very evident to the worker that a given amount of chloroform is more efficacious at a higher than at a lower temperature, that the optimum point recedes as the temperature rises. It was impossible to keep the temperature of the room in which the cultures were grown constant for any considerable period, but the truth of the statement was many times manifest at various stages in the development. In one or two instances when the crop ripened at from 32–34° C., the optimum was pushed back from $\frac{1}{2}$–$\frac{7}{12}$ to $\frac{5}{12}$ or even $\frac{1}{3}$ c.c. per litre.

The facts indicated are, that:

1. When present in small quantities $CHCl_3$ vapor acts as a characteristic stimulant to the growth of *Sterigmatocystis nigra* and *Penicillium glaucum.*

2. Larger quantities are inimical or fatal.

3. Increased growth is attended by relatively less acid formation and less sugar consumption indicating greater economy in metabolism.

4. The time of greatest sensitiveness is at the germination of the spores.

5. $CHCl_3$ acts as a stimulant purely since it cannot be a source of carbon.

6. The effect of a given amount of the anaesthetic is greater as the temperature rises.

BARNARD COLLEGE, COLUMBIA UNIVERSITY,
April, 1905.

TABLE I.

Sterigmatocystis nigra.—SOLUTION A.

	$CHCl_3$. per li.	Net Weight.	Per Cent. Increase Over Normal.	Oxalic Acid by Weight	Oxalic Acid per gm Fungus.	Sugar Used.	Economic Coefficient. Sugar: Fungus.	Fungus: Sugar.
	c.c.	grams.		grams.	grams.	grams.		
Series I.	0	.5836	—	.3942	.6754	2.7069	4.6378	.2156
Time 14 days.	0	.6628	—	.4097	.6181	3.0790	4.6454	.2152
Temp. 26°–33°C.	1/3	.7400	18.74	.2164	.2924	2.1130	2.8554	.3502
10% sugar sol.	5/12	.7360	18.10	.1597	.2170	2.2754	2.9820	.3353
	1/2	.6838	9.72	.2860	.4182	1.9804	2.8960	.3453
	7/12	.7088	13.73	.1468	.2071	1.9885	2.8054	.3564
Series II.	0	.1850	—	.1933	1.044	.7926	4.284	.2334
Time 12 days.	0	.2128	—	.1571	.7382	.8888	4.176	.2394
Temp. 24°–27°C.	5/12	.2950	48.31	.3622	1.227	1.3099	4.437	.2254
	1/2	.3314	66.62	.2566	.7743	1.5031	5.435	.2204
	7/12	.4216	111.9	.2203	.5225	1.6829	3.991	.2505
	2/3	.3110	56.36	.1764	.5672	1.3443	4.321	.2314
Series III.	0	.1806	—	.1996	1.105	.7502	4.164	.2407
Time 12 days.	0	.1294	—	.1585	1.224	.5492	4.487	.2228
Temp. 24°–27°C.	5/12	.5036	224.9	.1558	.3093	1.5577	3.091	.3309
	1/2	.4530	192.2	.1276	.2816	1.3916	3.072	.3255
	7/12	.2448	57.93	.0866	.3537	.6952	2.839	.3521
	2/3	.1598	3.10	.0618	.3867	.4482	2.804	.4488
Series IV.	0	.1750	—	.1392	.7954	.639	3.651	.2738
Time 12 days.	0	.0790	—	.0928	1.174	.281	3.557	.2811
Temp. 22°–28°C.	1/3	.2620	106.3	.1624	.6198	1.084	4.137	.2147
	5/12	.2710	113.4	.1753	.6468	1.080	3.985	.2509
	1/2	.2100	65.4	.1469	.6995	.833	3.966	.2521
	7/12	.2780	118.9	.1469	.5284	1.178	4.237	.2359
	2/3	.2226	75.3	.1005	.4535	1.062	4.770	.2096
	3/4	.1690	33.1	.1237	.7319	.813	4.810	.2078
Series V.	0	.0920	—	.1391	1.512	.462	5.021	.1991
Time 9 days.	0	.0640	—	.1121	1.751	.353	5.515	.1813
Temp. 26°–31°C.	1/3	.1170	50.0	.2589	2.212	.595	5.0[illegible]5	.1966
	5/12	.1550	98.7	.2705	1.745	.747	4.819	.2075
	1/2	.1370	75.6	.2628	1.918	.704	5.138	.1946
	7/12	.1590	103.8	.2551	1.604	.767	4.824	.2073
	2/3	.1110	44.3	.2164	1.949	.630	5.676	.1761
	3/4	.1750	124.3	.2056	1.174	.837	4.783	.2090
Series VI.	0	.0564	—	.0773	1.371	0.181	3.195	.3130
Time 7 days.	0	.0360	—	.0619	1.719	0.141	3.917	.2553
Temp. 27°–34°C.	1/3	.3650	690.0	.2783	0.762	1.480	4.055	.2466
	5/12	.2020	337.2	.1739	0.861	0.750	3.713	.2693
	1/2	.2720	488.7	.1662	0.611	0.623	2.290	.4366
	7/12	.2736	492.2	.1971	0.724	0.976	3.567	.2803
	2/3	.2256	388.3	.1469	0.651	0.623	2.761	.3621
	3/4	.2246	386.1	.1469	0.654	0.701	3.121	.3204

TABLE I.—*Concluded.*

Sterigmatocystis nigra.—SOLUTION A.

	$CHCl_3$ per li.	Net Weight.	Per Cent. Increase Over Normal.	Oxalic Acid by Weight.	Oxalic Acid per gm. Fungus	Sugar Used.	Economic Coefficient. Sugar : Fungus.	Economic Coefficient. Fungus : Sugar.
	c.c.	grams.		grams.	grams.	grams.		
Series VII.	0	.0200	—	.0541	2.705	.253	12.64	.0791
Time 10 days.	0	.0280	—	.0541	1.932	.290	10.35	.0967
Temp. 24°–30°C.	1/3	.1290	437.5	.1852	1.436	.574	4.453	.2246
	5/12	.1340	458.3	.0696	0.5194	.518	3.865	.2587
	1/2	.1952	713.3	.0812	0.4160	.627	3.214	.3111
	7/12	.1960	716.7	.0696	0.3551	.627	3.201	.3124
	2/3	.1854	672.5	.0696	0.3754	.653	3.520	.2841
	3/4	.1420	491.7	.0501	0.3528	.326	2.296	.4356
Series VIII.	0	.0570	—	.1314	2.305	.343	6.025	.1659
Time 13 days.	0	.0660	—	.1275	1.932	.361	5.462	.1830
Temp. 24°–30°C.	1/3	.0980	59.4	.1469	1.499	.488	4.984	.2006
	5/12	.1990	223.6	.0696	0.3497	.574	2.885	.3387
	1/2	.1810	194.3	.0773	0.4271	.713	3.940	.2538
	7/12	.2650	330.9	.0696	0.2626	.701	2.647	.3778
	2/3	.1880	205.7	.0503	0.2676	.427	2.287	.4408
	3/4	.1130	83.7	.0194	0.1717	.253	2.237	.4470
Series IX.	0	.0820	—					
Time 21 days.	0	.0987	—					
Temp. 23°–25°C.	1/3	.1810	101.3					
	5/12	.1930	114.7					
	1/2	.2508	178.9					
	7/12	.1510	68.0					
	2/3	.3594	299.8					
	3/4	.2390	165.9					

TABLE II.

AVERAGES OF DATA GIVEN IN TABLE I.

$CHCl_3$ per li.	Net Weight.	Per Cent. Increase Over Normal.	Oxalic Acid by Weight.	Oxalic Acid per gm. Fungus.	Sugar Used.	Economic Coefficient.	
						Sugar: Fungus.	Fungus: Sugar.
c.c.	grams.		grams.	grams.	grams.		
0	—	—	0.1563	1.4123	0.754	5.3579	0.2122
$\frac{1}{3}$	0.2702	209.0	0.2080	1.1368	1.056	4.2615	0.2388
$\frac{5}{12}$	0.2987	181.9	0.1796	0.7344	1.101	3.722	0.2771
$\frac{1}{2}$	0.3015	220.5	0.1756	0.6932	1.047	3.744	0.2924
$\frac{7}{12}$	0.2998	223.7	0.1490	0.5696	1.077	3.514	0.2966
$\frac{2}{3}$	0.2518	249.3	0.1174	0.6643	0.741	3.734	0.3076
$\frac{3}{4}$	0.1771	214.1	0.1091	0.6168	0.586	3.449	0.3239

TABLE III.

Sterigmatocystis nigra.—SOLUTION C.

	$CHCl_3$ per li.	Net Weight.	Sugar Used.	Economic Coefficient.	
				Sugar: Fungus.	Fungus: Sugar.
	c.c.	grams.	grams.		
Series X.	0	0.0596	1.167	19.58	0.0511
Time 7 days.	0	0.0340	1.167	34.32	0.0291
Temp. 25°–32° C.	$\frac{1}{12}$	0.0210	0.858	40.86	0.0245
	$\frac{1}{6}$	0 0290	0.858	29.59	0.0339
	$\frac{1}{4}$	0.1150	1.038	9.026	0.1108
	$\frac{1}{3}$	0.0720	0.930	12.91	0.0774
	$\frac{5}{12}$	0.0650	0.832	12.80	0.0781
	$\frac{1}{2}$	0.1120	0.930	8.303	0.1204
Series XI.	0	0.0886			
Time 7 days.	$\frac{1}{3}$	0.3106			
Temp. 30°–31° C.	$\frac{5}{12}$	0.3610			
	$\frac{1}{2}$	0.2340			
Series XII.	0	0.1910			
Time 4 days.	0	0.1660			
Temp. 32°–34° C.	$\frac{1}{6}$	0.2810			
	$\frac{1}{4}$	0.2860			
	$\frac{1}{3}$	0.1920			
Series XIII.	0	0.4470			
Time 4 days.	0	0.3520			
Temp. 27°–32° C.	$\frac{1}{12}$	0.2200			
	$\frac{1}{6}$	0.4660			
	$\frac{1}{4}$	0.5790			
	$\frac{1}{3}$	0.2130			
	$\frac{5}{12}$	0.2120			
	$\frac{1}{2}$	0.1980			

TABLE IV

Sterigmatocystis nigra.—SOLUTION A

	$CHCl_3$ per li.	Net Weight.	Oxalic Acid by Weight.	Oxalic Acid per Gm. Fungus.	Sugar Used.	Economic Coefficient. Sugar: Fungus.	Economic Coefficient. Fungus: Sugar.
Series XIV.	c.c.	grams.	grams.	grams.	grams.		
Temp. 24°–31° C.	0	0.1470	0.1276	0.8680	0.477	3.245	0.3082
$CHCl_3$ in before ger-	0	0.0950	0.1044	1.099	0.274	2.884	0.3467
mination, out after ger-	$\frac{1}{2}$	0.3200	0.1121	0.3503	0.899	2.809	0.3559
mination, *i. e.*, in 7 days. Total time 9 days.	$\frac{7}{12}$	0.1500	0.0348	0.2320	0.365	3.063	0.4110
$CHCl_3$ after germina-	0	0.0840	0.1585	1.887	0.441	5.250	0.1905
tion, *i. e.*, after 2 days;	0	0.0794	0.1778	2.239	0.365	4.597	0.2175
$CHCl_3$ in 10 days.	$\frac{1}{2}$	0.1240	0.0309	0.2492	0.404	3.258	0.3069
Total time 12 days.	$\frac{7}{12}$	0.2530	0.0619	0.2447	0.640	2.530	0.3953
Series XV.							
Temp 27°–32° C.	0	0.2200	0.1925	0.8750	0.957	4.350	0.2299
$CHCl_3$ in before ger-	0	0.1336	0.2040	1.527	0.777	5.816	0.1719
mination, out after ger-	$\frac{1}{2}$	0.2760	0.1584	0.5739	1.015	3.677	0.2719
mination, *i. e.*, in 3 days. Total time 7 days.	$\frac{7}{12}$	0.3040	0.1198	0.3941	0.996	3.431	0.2915
$CHCl_3$ in after germi-	0	0.1780	0.2744	1.542	0.936	5.258	0.1902
nation, *i. e.*, after 2	0	0.1350	0.2435	1.804	0.751	5.563	0.1798
days; $CHCl_3$ in 8	$\frac{1}{2}$	0.0490	0.0154	0.3143	0.257	5.245	0.1907
days. Total time 10 days.	$\frac{7}{12}$	0.0280	0.0193	0.6893	0.257	9.178	0.1089
Series XVI.							
Temp. 23°–29° C.	0	0.0780					
$CHCl_3$ in before ger-	$\frac{1}{2}$	0.3730					
mination, in 4 days. Total time 14 days.	$\frac{7}{12}$	0.1700					
$CHCl_3$ in after germi-	0	0.1190					
nation. In 14 days.	$\frac{1}{2}$	0.2000					
Total time 16 days.	$\frac{7}{12}$	0.2676					
Series XVII.							
Temp. 26°–28° C.	0	0.0674					
$CHCl_3$ in before ger-	$\frac{1}{2}$	0.1470					
mination. In 4 days. Total time 8 days.	$\frac{7}{12}$	0.1530					
$CHCl_3$ in after germi-	0	0.1040					
nation. In 12 days.	$\frac{1}{2}$	0.0330					
Total time 12 days.	$\frac{7}{12}$	0.1040					

TABLE V

Penicillium glaucum.—SOLUTION A

	$CHCl_3$ per li.	Net Weight.	Sugar Used.	Economic Coefficient.	
				Sugar : Fungus.	Fungus : Sugar.
	c.c.	grams.	grams.		
Series XVIII.	0	0.0330	0.288	8.727	0.1145
Time 17 days.	0	0.0620	0.397	6.403	0.1561
Temp. 18°–26° C.	1/2	0.1320	0.726	5.500	0.1818
	1/6	0.1124	0.532	4.733	0.2112
	1/4	0.1054			
	1/3	0.0950	0.523	5.505	0.1816
	5/12	0.0540	0.302	5.592	0.1788
	1/2	0.0416	0.257	6.178	0.1618
Series XIX.	0	0.0664			
Time 14 days.	0	0.0930			
Temp. 19°–24° C.	1/12	0.0700			
	1/6	0.1580			
	1/4	0.2980			
	1/3	0.0400			
	5/12	0.0760			
	1/2	0.0400			
Series XX.	0	0.0490			
Time 19 days.	0	0.0534			
Temp. 21°–26° C.	1/12	0.0720			
	1/6	0.0950			
	1/4	0.0580			
	1/3	0.0268			
	5/12	0.0570			
	1/2	0.0300			

The Polyporaceae of North America — XI. A synopsis of the brown pileate species

William Alphonso Murrill

An attempt is made in the present paper to summarize in convenient form for reference the results of former studies covering all North American polypores having a distinct pileus with dark-colored substance, and, in addition, to give generic keys and diagnoses of new genera not already treated that come within this subgroup.

Family POLYPORACEAE

Hymenophore annual or perennial: context fleshy-tough, corky or woody; hymenium poroid or lamelloid, fleshy to woody, never gelatinous.

Synopsis of the subfamilies

Hymenium porose.
  Hymenophore annual. — 1. Polyporeae.
  Hymenophore perennial. — 2. Fomiteae.
Hymenium furrowed. — 3. Agariceae.

Subfamily 1. Polyporeae

Hymenophore varied in size and shape, fleshy-tough to corky, annual, sometimes reviving and rarely perennial in the tropics; surface encrusted or anoderm, glabrous or hairy, zonate or azonate: context fibrous, rarely punky, variously colored; tubes cylindrical, sometimes splitting into teeth, usually thin-walled: spores rounded or oblong, brown or hyaline, cystidia frequently present, surface of pileus never conidia-bearing: stipe often present, variously attached.

Synopsis of the Polyporeae with brown context

Hymenophore sessile.
  Spores hyaline.
    Context light-brown.
      Context at first fleshy, becoming slightly corky. — 1. *Ischnoderma.*
      Context tough from the first.
        Surface encrusted. — 2. *Antrodia.*
        Surface not encrusted.
          Surface glabrous or nearly so.

Hymenium alveolate.	3. *Favolus.*
Hymenium normally poroid.	4. *Hapalopilus.*
Surface distinctly hairy.	
Tubes large and irregular.	5. *Funalia.*
Tubes small and regular.	6. *Coriolopsis.*
Context dark-brown.	
Context duplex, mostly of intricately woven black hairs.	7. *Trichaptum.*
Context simple.	
Context friable.	14. *Phaeolus.*
Context tough.	
Tubes yellow.	8. *Flaviporus.*
Tubes brown, rarely greenish.	
Tubes entire, surface heavily bearded.	9. *Pogonomyces.*
Tubes soon splitting into teeth, surface velvety.	10. *Cerrenella.*
Tubes black.	11. *Nigroporus.*
Spores brown.	
Hymenophore thin, dry, multizonate.	12. *Cyclomycetella.*
Hymenophore not as above.	13. *Inonotus.*
Hymenophore stipitate.	
Spores hyaline.	14. *Phaeolus.*
Spores brown.	
Pileus inverted, pendant.	15. *Coltriciella.*
Pileus erect, stipe central.	16. *Coltricia.*

1. ISCHNODERMA Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 38. 1879

Type: *Ischnoderma fuliginosum* (Scop.) Murr.

Hymenophore large, annual, epixylous, sessile; surface pelliculose, glabrous: context light-brown, fleshy to slightly corky, friable when dry; tubes small, thin-walled: spores smooth, hyaline.

Species: *I. fuliginosum* (Scop.) Murr. [see Bull. Torrey Club 31: 606, 607. 1904.]

2. ANTRODIA Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 40. 1879

Type: *Antrodia mollis* (Sommerf.) Karst.

Hymenophore small, annual, epixylous, sessile or semi-resupinate; surface zonate, encrusted, glabrous: context thin, light-brown, fibrous; tubes short, firm, thin-walled: spores smooth, hyaline.

ANTRODIA MOLLIS (Sommerf.) Karst.

Daedalea mollis Sommerf. Suppl. Fl. Lapp. 271. 1826.

Trametes mollis Fr. Hym. Eur. 585. 1871.

Antrodia mollis Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 40. 1879.

Trametes stereoides Bres. Att. I. R. Accad. Sc. ed Art. III. **3**: 92. 1897.

According to Bresadola, this species is the same as *Polyporus stereoides* Fr. (Obs. Myc. **2**: 258. 1818), described from very small specimens collected on old fir trunks in Sweden, but different from *Polyporus cervinus* of Persoon (Myc. Eur. **2**: 87. 1825).

The plant is fairly well known in Europe and temperate North America on decaying wood of beech, maple, linden and other deciduous trees: Finland, *Karsten;* Hungary, *Kmet;* Tyrol, *Bresadola;* Canada, *Ellis, Macoun, Dearness;* Maine, *Blake;* New York, *Peck;* Ohio, *Lloyd.*

3. FAVOLUS Beauv. Fl. Owar **1**: 1. *pl. 1.* 1805

Type: *Favolus hirtus* Beauv.

Scenidium Kuntze, Revis. Gen. 515. 1893.

Type: *Favolus hirtus* Beauv.

Hymenophore small, annual, epixylous, sessile, dimidiate or reniform; surface multizonate, margin thin: context thin, leathery, pallid or brown; tubes alveolar: spores smooth, hyaline.

Species: *F. tenuis* (Hook.) Murr., *F. variegatus* (Berk.) Murr. [see Bull. Torrey Club **32**: 99–103. 1905]. Although typically white-fleshed, this genus contains brown forms and *F. variegatus* is usually brown.

4. HAPALOPILUS Karst. Rev. Myc. **3**: 18. 1881

Type: *Hapalopilus rutilans* (Pers.) Murr.

Hymenophore annual, very rarely perennial in the tropics, epixylous, sessile, dimidiate, simple or imbricate; surface anoderm, rarely pelliculose, zonate or azonate, usually brown and glabrous: context brown, leathery or corky, tough or rarely friable when dry; hymenium usually differently colored, tubes small, thin-walled: spores small, usually ovoid, hyaline.

Species: *H. rutilans* (Pers.) Murr., *H. sublilacinus* (Ell. & Ev.) Murr., *H. licnoides* (Mont.) Murr., *H. gilvus* (Schw.) Murr., *H. fulvitinctus* (B. & C.) Murr., *H. hispidulus* (B. & C.) Murr. [see Bull. Torrey Club **31**: 415–419. 1904].

5. FUNALIA Pat. Tax. Hymen. 95. 1900

Type: *Funalia Mons-Veneris* (Jungh.) Pat.

Hymenophore annual, epixylous, sessile, dimidiate, often semi-resupinate; surface anoderm, hairy: context light-brown, duplex, spongy above, coriaceous to woody below; tubes usually large, thin-walled, more or less lacerate: spores smooth, hyaline.

Synopsis of the North American species

1. Northern species; context thick, firm, tubes circular to angular, concolorous. 1. *F. stuppea.*
   Southern species, confined to the Gulf States and tropical America. 2.
2. Surface hairs small and simple, entire plant soft and flexible. 2. *F. villosa.*
   Surface hairs conspicuously branched and tufted, plant more or less rigid. 3. *F. cladotricha.*

1. Funalia stuppea (Berk.)

Trametes stuppeus Berk. Ann. Nat. Hist. **7**: 453. 1841.
Trametes Peckii Kalchb. Bot. Gaz. **6**: 274. 1881.

Described originally from Dr. Richardson's collections at Carlton House, British America, in 1841 and again forty years later from specimens collected by Irish on dead cottonwood trunks in Dakota. Kalchbrenner's description is translated by Peck as follows:

"Pileus corky, dimidiate, sessile, subdecurrent, hairy, zoneless, brownish-ferruginous, becoming pale, the margin acute; pores rather large, varying from rotund to angular, colored nearly like the pileus or when old becoming brown; substance wood-color."

This species is abundant in certain parts of northern and western North America on dead stumps and trunks of cottonwood and other species of poplar. What appears to be a modified form of the same plant has been found on dead willow trees in Kansas. Although similar, all forms of this species are distinct from *Trametes hispida* Bagl. of Europe.

British Columbia, *Macoun;* Montana, *Anderson;* Dakota, *Irish;* Colorado, *Crandall, Cowen;* Kansas, *Bartholomew;* Missouri, *Demetrio;* New Mexico, *Earle.*

2. Funalia villosa (Sw.)

Boletus villosus Sw. Prodr. 148. 1788. Fl. Ind. Occ. **3**: 1923. 1806.
Favolus villosus Fr. Syst. Myc. **1**: 344. 1821.
Polyporus villosus Fr. Epicr. 475. 1836–38.

Described originally from plants collected on dead trees in Jamaica as follows:

"B. acaulis, submembranaceus fasciatus griseo-albidus villosus, poris difformibus dentatis."

In his later work Swartz largely supplements the above description. Fries probably did not see the plant until after 1821. Resupinate Cuban forms were determined by Berkeley as *Polyporus cavernulosus* Berk. (Hook. Jour. Bot. **8**: 235. 1856), first described from Brazil, while semi-resupinate and pileate forms from tropical America and the Gulf States have long been known as *Polyporus versatilis* Berk. (Lond. Jour. Bot. **1**: 150. 1842), described originally from Cuming's collections in the Philippines.

This species is fairly common in the West Indies and Central America, and has been collected in quantity by Langlois in Louisiana. It appears to grow equally well on deciduous and coniferous wood, and varies much in appearance, consistency and size of pores, on all hosts.

Louisiana, *Langlois*; Florida, *Calkins*; Jamaica, *Earle 430*; Cuba, *Earle & Murrill 169, 294, 550, 598, 626*; Nicaragua, *Smith*, *Shimek*.

3. **Funalia cladotricha** (B. & C.)

Polyporus cladotrichus B. & C. Jour. Linn. Soc. Bot. **10**: 309. 1868.

Collected by Wright on dead wood in Cuba and thus described:

"Pileo dimidiato vel e decurrente reflexo strigoso brunneo; poris mediis angulatis, dissepimentis rigidis demum laceratis dentatis."

"Pileus 2–3 inches broad, 1–2 inches long; pores $\frac{1}{36}$ inch in diameter, 2 lines deep. The pileus has a spongy strigose coating, but not consisting of decumbent fibres as in the last (*P. trichomallus*). *P. endothrix* Berk., from the river Amazon, has much smaller pores."

SPECIES INQUIRENDAE

Polyporus Lindheimeri B. & C. Grevillea **1**: 50. 1872. Described from plants collected by Lindheimer on *Laurus Sassafras* in Texas as follows:

"Pileus $1\frac{1}{4}$ inch wide, $\frac{1}{2}$ long, often laterally confluent, dirty white, tinged with ash-color, floccose, here and there slightly strigose; hymenium cinereous; pores $\frac{1}{100}$ inch wide, angular."

The type of this species at Kew is very old and partially destroyed by insects, so that little can be known of the plant until new collections are made in the type locality.

6. **Coriolopsis** gen. nov.

Type: *Polyporus occidentalis* Kl. Linnaea **8**: 486. 1833.

Hymenophore thin, flexible or rigid, annual, epixylous, sessile, dimidiate, often largely resupinate; surface light-brown, zonate, anoderm, hairy, margin thin: context thin, coriaceous to woody, pale ferruginous, sometimes almost white; hymenium concolorous, tubes small, regular, thin-walled, entire: spores smooth, hyaline.

Synopsis of the North American species.

1. Pores conspicuous. 2.
   Pores inconspicuous, pileus papery, thin, very flexible. 1. *C. crocata.*
2. Pores yellowish-brown, pileus usually rather thick and firm. 2. *C. occidentalis.*
3. Pores white or pallid, pileus thin, often narrowly reflexed or entirely resupinate. 3. *C. gibberulosa.*

1. **Coriolopsis crocata** (Fr.)

Polyporus crocatus Fr. Epicr. 477. 1836–38.
Polyporus byrsinus Mont. Pl. Cell. Cuba 391. *pl. 15. f. 3.* 1842.
Polystictus crocatus Fr. Nov. Symb. 91. 1851.

Described originally from plants collected on trunks in Mexico by Liebmann. Confused with *C. occidentalis* by many, but plainly distinct. The species has until recently been but sparingly collected in tropical America, as the following specimens at hand will indicate.

Colombia, *Baker;* Nicaragua, *Wright 237, Smith;* Mexico, *Smith;* Cuba, *Wright 306½; Underwood & Earle 1580, Earle & Murrill 121, 125, 237, 351, 379, 499, 644.*

2. **Coriolopsis occidentalis** (Kl.)

Polyporus occidentalis Kl. Linnaea **8**: 486. 1833.
Polyporus lenis Lév. Ann. Sci. Nat. Bot. III. **9**: 123. 1848.
Polystictus cyclodes Fr. Nov. Symb. 90. 1851.

This species was first described from plants in Hooker's herbarium, collected on trunks in the island of St. Vincent by Guilding. *Polyporus lenis* was assigned to specimens collected on trunks in America by Mougeot and *Polystictus cyclodes* to collections made in the island of San Jan by Oersted. These are probably not half of the names under which the species has been known.

The plant is exceedingly common on dead wood of various kinds throughout tropical America, the following list comprising only a few of the numerous collections examined:

Colombia, *Baker;* Yucatan, *Millspaugh;* Honduras, *Wilson, Brown;* Mexico, *Smith;* Jamaica, *Earle;* Cuba, *Earle, Murrill, Underwood, Britton, Shafer, Hamilton;* Porto Rico, *Earle.*

3. **Coriolopsis gibberulosa** (Lév.)

Polyporus gibberulosus Lév. Ann. Sci. Nat. Bot. III. **5**: 139. 1846.

Polystictus extensus Cooke; Sacc. Sylloge Fung. **6**: 244. 1888.

Described by Léveillé from Kegel's collections in Dutch Guiana and by Cooke from specimens named by Berkeley in the Hooker herbarium, collected in British Guiana. Cooke published Berkeley's name in Grevillea **14**: 82. 1886 without a description.

The species ranges northward in varying forms to Central America and the West Indies. The context is not white, but pale ferruginous. Specimens are at hand from Ecuador, *Lagerheim;* Colombia, *Baker;* Mexico, *Smith, Shimek;* Nicaragua, *Smith, Baker 2513;* Jamaica, *Earle 480;* Cuba, *Earle 548, 580, 1105, Underwood & Earle 1496, 1500, Earle & Murrill 30, 85, 119, 120, 128, 134, 136, 206, 214, 218, 223, 259, 330, 343, 368, 384, 394, 400, 418, 452, 645.*

SPECIES INQUIRENDAE.

Polyporus myrrhinus Kickx, Bull. Acad. Bruxell. **5**: 370. 1838.

Polystictus cascus Fr. Nov. Symb. 88. 1851.

Trametes rigida Berk. & Mont. Ann. Sci. Nat. Bot. III. **11**: 240. 1849. (*Polystictus rigens* Sacc. & Cub.; Sacc. Sylloge Fung. **6**: 274. 1888.)

7. TRICHAPTUM Murr. Bull. Torrey Club **31**: 608. 1904

Type: *Trichaptum trichomallum* (Berk. & Mont.) Murr.

Hymenophore annual, epixylous, sessile, dimidiate: context brown, firm and leathery below, very loosely fibrous and darker above; tubes short, thin-walled, mouths polygonal, at times becoming labyrinthiform: spores smooth, hyaline.

Species: *T. trichomallum* (Berk. & Mont.) Murr. [see Bull. Torrey Club **31**: 608, 609. 1904].

8. **Flaviporus** gen. nov.

Type: *Polyporus rufoflavus* B. & C. Jour. Linn. Soc. Bot. **10**: 310. 1868.

Hymenium annual, often reviving, epixylous, sessile, dimidiate, imbricate; surface encrusted, glabrous: context thick, woody, brown; tubes thin-walled, minute, regular: spores smooth, hyaline.

Synopsis of the North American species

Hymenium pale lemon-yellow. 1. *F. rufoflavus.*
Hymenium deep orange-colored. 2. *F. crocitinctus.*

1. **Flaviporus rufoflavus** (B. & C.)

Polyporus rufoflavus B. &. C. Journ. Linn. Soc. Bot. **10**: 310. 1868.

Polyporus Braunii Rabh. Rabenhorst's Fung. Europ. Exsic. *no. 2005.*

Described from Wright's collections in Cuba. Known also from Venezuela through Fendler, and from Mexico through the collections of C. L. Smith. Plants later described as *P. Braunii* were found on palms, which were doubtless brought from tropical America. The name assigned by Berkeley refers to the red surface and bright-yellow hymenium of the plant.

2. **Flaviporus crocitinctus** (B. & C.)

Polyporus crocitinctus B. & C. Journ. Linn. Soc. Bot. **10**: 311. 1868.

The type, collected in Cuba by Wright, is well preserved at Kew. The species has not since been collected.

9. POGONOMYCES Murr. Bull. Torrey Club **31**: 609. 1904

Type: *Pogonomyces hydnoides* (Sw.) Murr.

Hymenophore annual, epixylous, dimidiate-sessile to flabelliform, thickly covered with rigid hairs: context dark-brown, punky; tubes short, thick-walled, light brown, mouths small, circular: spores smooth, hyaline.

Species: *P. hydnoides* (Sw.) Murr. [see Bull. Torrey Club **31**: 609, 610. 1904].

10. **Cerrenella** gen. nov.

Type: *Irpex tabacinus* B. & C. Grevillea **1**: 102. 1872.

Hymenophore thin, effused-reflexed, annual, epixylous; surface brown, zonate, anoderm, margin thin: context thin, coriaceous, brown; hymenium at first poroid, very soon becoming irpiciform, the teeth irregular and compressed: spores smooth, hyaline.

Synopsis of the North American species

Hymenium concolorous, teeth bright-brown in color. 1. *C. tabacina.*
Hymenium of a different color from the pileus, teeth covered with a greenish bloom. 2. *C. coriacea.*

1. **Cerrenella tabacina** (B. & C.)

Irpex tabacinus B. & C. Grevillea **1**: 102. 1872.

Described from plants collected by Curtis in the Carolinas. Its favorite host is decaying limbs of oak.

Ravenel, Fung. Car. 3: *22*; Georgia, *Ravenel*; Florida, *Lloyd*, *Calkins*; Louisiana, *Langlois*; Missouri, *Demetrio*..

2. **Cerrenella coriacea** (B. & Rav.)

Irpex coriaceus B. & Rav. Grevillea **1**: 101. 1872.

Described from Ravenel's South Carolina collections on dead oak branches. According to Berkeley, this species was described by Léveillé from Bogota as *Hydnum trachyodon* (Ann. Sci. Nat. III. **5**: 302. 1846) and was likewise found by Wright in Cuba (*I. trachyodon* B. & C. Jour. Linn. Soc. Bot. **10**: 326. 1868.

South Carolina, *Ravenel*; Alabama, *Peters*; Iowa, *Holway*.

SPECIES INQUIRENDAE

Irpex pityreus B. & C. Described from small specimens collected by Bennett in Rhode Island.

11. **Nigroporus** gen. nov.

Type: *Polyporus vinosus* Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852.

Hymenium annual, epixylous, dimidiate-sessile to flabelliform, glabrous: context dark-brown, firm, homogeneous; tubes short, slender, thin-walled, black: spores smooth, hyaline.

Nigroporus vinosus (Berk.)

Polyporus vinosus Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852.

Described from plants collected in San Domingo. The species is easily recognized by its wine-colored context.

Cuba, *Wright*, *Earle & Underwood 1574*, *Earle & Murrill 139*.

12. CYCLOMYCETELLA Murr. Bull. Torrey Club **31**: 422. 1904

Type: *Cyclomycetella pavonia* (Hook.) Murr.

Hymenophore annual, tough, epixylous, sessile, anoderm, zonate: context thin, fibrous, brown; tubes short, thin-walled, mouths polygonal, becoming concentrically elongated in some species by the splitting of the radial walls: spores ellipsoidal, smooth, ferruginous.

Species: *C. pavonia* (Hook.) Murr. [see Bull. Torrey Club **31**: 422, 423. 1904].

13. INONOTUS Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879

Type: *Inonotus cuticularis* (Bull.) Karst.

Inoderma Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. Not *Inoderma* S. F. Gray 1821.

Type: *Inoderma radiatum* (Sow.) Karst.

Inodermus Quél. Ench. Fung. 173. 1886.

Type: *Inodermus hispidus* (Bull.) Quél.

Phaeoporus Schroet. Krypt. Fl. Schles. **3**: 489. 1888.

Type: *Inonotus cuticularis* (Bull.) Karst.

Hymenophore annual, epixylous, sessile, dimidiate, simple or somewhat imbricate, variable in size; surface usually anoderm, brown, hairy or glabrous: context brown, thin and fibrous to spongy or corky; hymenium concolorous, often covered with whitish powder in youth, tubes small, thin-walled: spores smooth, light to dark brown.

Species: *I. hirsutus* (Scop.) Murr., *I. perplexus* (Peck) Murr., *I. dryophilus* (Berk.) Murr., *I. texanus* Murr., *I. jamaicensis* Murr., *I. corrosus* Murr., *I. Wilsonii* Murr., *I. pusillus* Murr., *I. radiatus* (Sow.) Karst., *I. amplectens* Murr., *I. fruticum* (B. & C.) Murr. [see Bull. Torrey Club **31**: 593–601. 1904].

14. PHAEOLUS Pat. Tax. Hymen. 86. 1900

Type: *Phaeolus Schweinitzii* (Fr.) Pat.

Romellia Murr. Bull. Torrey Club **31**: 338. 1904.

Type: *Romellia sistotremoides* (Alb. & Schw.) Murr.

Hymenophore large, irregular, annual, spongy to corky, epixylous; stipe simple, variously attached, wanting at times; surface of pileus anoderm, hispid: context ferruginous, tubes irregular, thin-walled: spores ellipsoidal, smooth, hyaline; cystidia none.

This genus was founded on **Phaeolus sistotremoides** (Alb. & Schw.) Murr. and twelve other species, the majority of which I do not consider congeneric with the type. When I published the genus *Romellia* I was ignorant of the fact that *Phaeolus* had been raised from the subgeneric rank assigned it in 1897 (Ann. Bot. Buitenz. First Suppl. 112).

Species: *P. sistotremoides* (Alb. & Schw.) Murr. [see Bull. Torrey Club **31**: 338–340. 1904].

15. COLTRICIELLA Murr. Bull. Torrey Club **31**: 348. 1904

Type: *Coltriciella dependens* (B. & C.) Murr.

Hymenophore small, annual, tough, epixylous; stipe attached to the vertex of the pileus; surface of the pileus anoderm, zonate: context spongy, fibrous, ferruginous, tubes angular, one-layered, dissepiments thin: spores ellipsoidal, smooth, ferruginous.

Species: *C. dependens* (B. & C.) Murr. [see Bull. Torrey Club **31**: 348. 1904].

16. COLTRICIA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821

Type: *Coltricia perennis* (L.) Murr.

Strilia S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.

Type: *Strilia cinnamomea* (Jacq.) S. F. Gray.

Pelloporus Quél. Ench. Fung. 166. 1886.

Type: *Pelloporus triqueter* (Secr.) Quél.

Mucronoporus Ell. & Ev. Jour. Myc. **5**: 28. *pl. 8.* 1889.

Type: *Mucronoporus tomentosus* (Fr.) Ell. & Ev.

Onnia Karst. Finlands Basidsv. 326. 1889.

Type: *Onnia circinata* (Fr.) Karst.

Xanthochrous Pat. Cat. Tun. 51. 1897.

Type: *Xanthochrous tomentosus* (Fr.) Pat.

Hymenophore annual, terrestrial or humus-loving, simple, small to medium, usually circular and central-stemmed; surface anoderm, brown, zonate or azonate: context brown, coriaceous to spongy; hymenium concolorous, covered with yellowish or whitish powder when young, tubes thin-walled, at length fimbriate: spores smooth, rounded, ferruginous, cystidia rarely present.

Species: *C. cinnamomea* (Jacq.) Murr., *C. perennis* (L.) Murr., *C. parvula* (Kl.) Murr., *C. tomentosa* (Fr.) Murr., *C. obesa* (Ell. & Ev.) Murr., *C. Memmingeri* Murr. [see Bull. Torrey Club **31**: 340–348. 1904].

Subfamily 2. FOMITEAE

Hymenophore large, woody, perennial, rarely small or annual; surface anoderm or encrusted, usually sulcate, sometimes varnished: context punky or woody, variously colored; tubes cylindrical, usually thick-walled: spores rounded, smooth or verrucose, hyaline or brown, cystidia frequently present, surface conidia-bearing in a few species: stipe rarely present, the hymenophore usually being sufficiently elevated by its host.

Annual forms and species in a few genera connect this group with the *Polyporeae;* while the tendency at times to produce a daedaleoid hymenium, shown especially in *Porodaedalea*, connects it with the *Agariceae.*

Synopsis of the Fomiteae with brown context

Surface of the hymenophore covered with reddish-brown varnish, context corky. — 1. *Ganoderma.*
Surface of the hymenophore not as above.
  Context olivaceous. — 2. *Fomitella.*
  Context brown or dark-red.
    Hymenophore plainly stipitate, simple. — 3. *Amauroderma.*
    Hymenophore subsessile, cespitose, arising from a common trunk or tubercle. — 4. *Globifomes.*
    Hymenophore truly sessile, dimidiate or ungulate, simple or imbricate.
      Hymenium labyrinthiform, varying to porose, tubes not distinctly stratified. — 5. *Porodaedalea.*
      Hymenium porose, tubes distinctly stratified.
        Pileus covered with a horny crust, context punky. — 6. *Elfvingia.*
        Pileus not covered with a horny crust, or, if encrusted, context woody. — 7. *Pyropolyporus.*
  Context dark-purple or black. — 8. *Nigrofomes.*

1. GANODERMA Karst. Rev. Myc. 3: 17. 1881

Type: *Ganoderma flabelliforme* (Scop.) Murr.

Placodes Quél. Ench. Fung. 170. 1886.

Type: *Ganoderma flabelliforme* (Scop.) Murr.

Hymenophore large, sessile or stipitate, perennial or annual, epixylous; surface sulcate, covered with reddish-brown varnish: context punky, brown, rarely pallid; tubes cylindrical, concolorous: spores ovoid, brown.

Species: *G. Tsugae* Murr., *G. flabelliforme* (Scop.) Murr., *G. sessile* Murr., *G. parvulum* Murr., *G. Oerstedii* (Fr.) Murr., *G. zonatum* Murr., *G. sulcatum* Murr., *G. nutans* (Fr.) Pat. [see Bull. Torrey Club **29**: 599–608. 1902].

2. **Fomitella** gen. nov.

Type: **Fomitella supina** (Sw.) Murr. (*Boletus supinus* Sw. Fl. Occ. Ind. **3**: 1926. 1806).

Hymenium sessile, at times semi-resupinate, applanate, epixylous; surface glabrous, anoderm to encrusted, sulcate with age: context woody or slightly punky, brownish-olivaceous, rarely varying to pallid; tubes minute, cylindrical, usually thick-walled, rarely stratose: spores smooth, hyaline.

Fomitella supina (Sw.)

Boletus resupinatus Sw. Prod. 149. 1788. Not *B. resupinatus* Fl. Dan. *pl. 844*.

Boletus supinus Sw. Fl. Occ. Ind. **3**: 1926. 1806.

Polyporus valenzuelianus Mont. Pl. Cell. Cuba 398. *pl. 15. f. 4*. 1842.

Polyporus guadelupensis Lév. Ann. Sci. Nat. Bot. III. **5**: 134. 1846.

Polyporus hemileucus B. &. C. Jour. Linn. Soc. Bot. **10**: 312. 1868.

Polyporus plebeius cubensis B. & C. Jour. Linn. Soc. Bot. **10**: 313. 1868.

The brief description originally given of this species in the Prodromus is slightly changed and much enlarged by the author in his Flora of the West Indies. He had in the meantime discovered that the plant is not always resupinate and that the earlier name was preoccupied. The habitat is here given as "Trunks of old trees in the mountains of Jamaica."

Montagne's description is characteristically complete and is accompanied by excellent figures. In commenting upon Berkeley's opinion that *P. valenzuelianus* is identical with *P. supinus* of Swartz, Montagne says that, if it is that species Swartz' name is "thoroughly inappropriate and repugnant." He then quotes Fries' comment in Novae Symbolae to the effect that the two species differ decidedly in color.

Only one specimen of *P. valenzuelianus*, so named, is to be found at Kew from the West Indies. The others are all from South Carolina and Georgia. In the United States, specimens have usually been determined as *P. hemileucus* B. & C., described originally from Cuba and identical with *P. valenzuelianus* and *P. supinus*.

Types of *P. plebeius cubensis* also agree with the above, though the specimens are older and more or less encrusted with a dark purplish covering.

Few polypores are more common in Cuba than this one and a good series of specimens showing nearly all known variations may often be picked from one log. There are, however, in the collection here some plants from Florida which show two variations not yet seen in specimens from elsewhere. Some of these have the context and pores nearly white, instead of olive-colored, and others show distinctly daedaleoid variations in the hymenium. How much the steam treatment used by Calkins may have affected these specimens it is difficult to say.

This species occurs on fallen deciduous wood throughout tropical America and the states bordering the gulf of Mexico, being found as far north as South Carolina.

Ell. & Ev. N. A. Fung. *1704*; Georgia, *Ravenel*, *Harper*; South Carolina, *Ravenel*; Alabama, *Earle*, *Baker*, *Underwood*; Louisiana, *Langlois*, *Lloyd*; Texas, *Hodson*; Florida, *Martin*, *Rau*, *Calkins*, *Rolfs*, *Ives*; Cuba, *Wright 252*, *Earle 153*, *Earle & Wilson 230*, *Earle & Underwood 588*, *1123*, *1501*, *1525*, *Earle & Murrill 107*, *205*, *224*, *230*, *255*, *342*, *358*, *360*, *370*, *483*, *527*, *593*; Porto Rico, *Earle 169*, *171*; Jamaica, *Underwood 2324*, *2832*, *2835*, *Earle 245 a*; Nicaragua, *C. L. Smith 74*.

3. **Amauroderma** gen. nov.

Type: **Amauroderma regulicolor** (Cke.) Murr.

Hymenophore large, epixylous, stipitate, the stipe often much elongated; surface smooth, encrusted, not varnished: context brown, punky; tubes cylindrical, concolorous, the mouths usually light-colored at first: spores ovoid or globose, brown.

The generic name here employed was used by Patouillard (Tax. Hymen. 105. 1900) for a subdivision of the genus *Ganoderma*, referring to the *dark*, namely, *not shining*, surface of certain species. Members of the genus within our limits are confined to the tropics.

Synopsis of the North American species

1. Pileus less than 5 cm. in diameter, simple, tubes 8 to a mm. — 1. *A. regulicolor*.
   Pileus 10 cm. or more in diameter. — 2.
2. Stipe laterally attached, plants cespitose, tubes 5 to a mm. — 2. *A. coffeatum*.
   Stipe centrally attached, plants simple, spores spherical, echinulate. — 3. *A. Chaperi*.

1. **Amauroderma regulicolor** (Cooke)

Fomes regulicolor Cooke, Grevillea **15**: 21. 1886.

This species occurs on decaying roots in Cuba, but is probably rare, being known only from the original collections.

2. **Amauroderma coffeatum** (Berk.)

Polyporus coffeatus Berk. Ann. Nat. Hist. **3**: 385. 1839.

Described from Guilding's collections in the island of St. Vincent. The species grows on decaying trunks, and is known only from the type locality.

3. **Amauroderma Chaperi** (Pat.)

Ganoderma Chaperi Pat. Jour. Botanique **4**: 197. 1890.

Described from plants collected by Chaper in Cuba and deposited in the herbarium at Paris.

4. GLOBIFOMES Murr. Bull. Torrey Club **31**: 424. 1904.

Type: *Globifomes graveolens* (Schw.) Murr.

Hymenophore large, woody, encrusted, perennial, epixylous, compound: context ferruginous, punky; tubes cylindrical, thick-walled, stratose: spores ovoid, smooth, ferruginous.

Species: *G. graveolens* (Schw.) Murr. *l. c.*

5. **Porodaedalea** gen. nov.

Type **Porodaedalea Pini** (Thore) Murr.

Hymenophore large, perennial, epixylous, sessile, conchate to ungulate; surface anoderm, sulcate, usually rough: context brown and woody; tubes concolorous, rarely in distinct layers, the hymenium varying from porose to daedaleoid: spores smooth, hyaline at maturity, becoming brownish with age, cystidia conspicuous.

Porodaedalea Pini (Thore)

Boletus Pini Thore, Chlor. Land. 487. 1803. Brot. Fl. Lusit. **2**: 468. 1804.

Daedalea Pini Fr. Syst. Myc. **1**: 336. 1821; Linnaea **5**: 514. 1830.

Polyporus Pini Pers. Myc. Eur. **2**: 83. 1825.

Fomes Abietis Karst. Bidr. Finlands Nat. och Folk **37**: 242. 1882.

Polyporus piceinus Peck, Rept. N. Y. State Mus. Nat. Hist. **42**: 25. 1889.

Trametes Pini Abietis Karst. Finlands Basidsv. 336. 1889.

This abundant and variable species was transferred to *Mucronoporus* by Ellis on account of its spiny hymenium, but it is best known as a *Trametes*. Besides its published specific names several manuscript names have been assigned to it, among which are *Polyporus gausapatus* Berk. & Rav. on pine, *Daedalea vorax* Harkness on *Abies Douglasii* in California and *Daedalea vetusta* Ell. & Hark., on white cedar in New Jersey.

It seems that this plant is more sensitive to changes in host than almost any other of its kind. One would expect a parasitic species like this to show more variation than an ordinary deadwood species, but the forms here assumed on different hosts and even on the same host under different conditions are surprising. I am supposing that the range of forms found on pine, spruce and other conifers represent a single species. They have all seemed so to me, and Dr. Schrenk expects shortly to prove their identity by the completion of a series of inoculation experiments covering various hosts.

The present species is too well known throughout both Europe and America as a destructive parasite of coniferous trees to require a list of specimens collected. All published exsiccati covering the group contain it and fresh material may be gathered in almost any locality.

6. ELFVINGIA Karst. Finlands Basidsv. 333. 1889.

Type: *Elfvingia lipsiensis* (Batsch) Murr.

Xylopilus Karst. Bidr. Finlands Nat. och Folk **37**: 69. 1882.

Type: *Xylopilus crassus* (Fr.) Karst.

Hymenophore large, epixylous, sessile, applanate or ungulate; surface sulcate, horny-encrusted: context brown, punky; tubes brown, cylindrical, stratose, thick-walled, mouths whitish when young: spores brown, rarely hyaline; conidia present in most species on the surface of the pileus.

Species: *E. fomentaria* (L.) Murr., *E. fasciata* (Sw.) Murr., *E. reniformis* (Morg.) Murr., *E. megaloma* (Lév.) Murr., *E. tornata* (Pers.) Murr., *E. Lionnetii* (Rolland) Murr. [see Bull. Torrey Club **30**: 296-301. 1903].

An examination of Schweinitz' type has shown his *Polyporus lobatus* to be a somewhat distorted form of *Elfvingia reniformis*. *P. lobatus* Schw. is not tenable, however, because of *P. lobatus* Schrad.

7. PYROPOLYPORUS Murr. Bull. Torrey Club **30**: 109. 1903.

Type: *Boletus igniarius* L.

Mison Adans. Fam. **2**: 10. 1763. Not associable with a binomial species.

Type: *Boletus igniarius* L. (Micheli's *pl. 62*).

Agaricon Adans. Fam. **2**: 10. 1763. Not *Agaricus* L. 1753.

.Type: *Boletus igniarius* L. (Tournefort's *pl. 333*).

Phellinus Quél. Ench. Fung. 172. 1886. Not *Phelline* Poir. 1826.

Type: *Boletus igniarius* L.

Hymenophore large, perennial, epixylous, sessile, ungulate or applanate; surface sulcate, usually anoderm and often rough or rimose: context woody or punky, brown, rarely dark-red; tubes brown, cylindrical, stratose, usually thick-walled: spores smooth, ferruginous, rarely hyaline.

Species: *P. igniarius* (L.) Murr., *P. fulvus* (Scop.) Murr., *P. crustosus* Murr., *P. Calkinsii* Murr., *P. Everhartii* (Ell. & Gall.) Murr., *P. Robiniae* Murr., *P. praerimosus* Murr., *P. Underwoodii* Murr., *P. juniperinus* (Schrenk) Murr., *P. Earlei* Murr., *P. conchatus* (Pers.) Murr., *P. Haematoxyli* Murr., *P. Langloisii* Murr., *P. Ribis* (Schum.) Murr., *P. yucatanensis* Murr., *P. senex* (Nees & Mont.) Murr., *P. linteus* (B. & C.) Murr., *P. jamaicensis* Murr. [see Bull. Torrey Club **30**: 109–120. 1903].

8. NIGROFOMES Murr. Bull. Torrey Club **31**: 425. 1904.

Type: *Nigrofomes melanoporus* (Mont.) Murr.

Hymenophore large, perennial, epixylous, sessile: context woody, purple; tubes cylindrical, stratose, thick-walled, black: spores ovoid, smooth, hyaline.

Species: *N. melanoporus* (Mont.) Murr. *l. c.*

Subfamily 3. AGARICEAE

Hymenium annual, very rarely perennial, coriaceous to woody, variable in size; surface anoderm, hairy or glabrous, variously marked: context white or brown, fibrous, woody or punky; hymenium exceedingly variable, normally labyrinthiform or lamelloid, but often poroid or even irpiciform, never stratified: spores smooth, brown or hyaline.

Poroid and irpiciform plants of this group are difficult to separate from certain species of the *Polyporeae*; forms of *Agaricus confragosus* in particular being troublesome to the beginner. On the other hand, there is little to cause confusion between this group and the *Fomiteae*, if we except the single distinctly perennial species of *Agaricus* and the daedaleoid forms of *Porodaedalea*.

Synopsis of the Agariceae with brown context

Hymenophore sessile, furrows radiate. 1. *Gloeophyllum*.
Hymenophore stipitate, furrows concentric. 2. *Cycloporus*.

1. GLOEOPHYLLUM Karst. Bidr. Finlands Nat. och Folk **37**: x, 79. 1882

Type: *Sesia hirsuta* (Schaeff.) Murr.

Sesia Adans. Fam. **2**: 10. 1763. Not associable with a binomial species.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Serda Adans. Fam. **2**: 11. 1763. Not associable with a binomial species.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Lenzitina Karst. Finlands Basidsv. 337. 1889.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Hymenophore small, annual, epixylous, sessile; surface hairy or glabrous, anoderm, often zonate: context tough, brown; hymenium normally lamelloid or daedaleoid, but frequently poroid in some species: spores smooth, hyaline.

According to the rules now followed by most American botanists *Sesia* must be replaced by *Gloeophyllum*, as follows:

Species: *Gloeophyllum hirsutum* (Schaeff.) Murr., **Gloeophyllum Berkeleyi** (Sacc.) Murr., **Gloeophyllum striatum** (Sw.) Murr., **Gloeophyllum pallidofulvum** (Berk.) Murr. [see Bull. Torrey Club **31**: 602–606. 1904].

2. CYCLOPORUS Murr. Bull. Torrey Club **31**: 423. 1904

Type: *Cycloporus Greenei* (Berk.) Murr.

Hymenophore annual, tough, anoderm, terrestrial, centrally stipitate: context soft, spongy, ferruginous; pores at first polygonal, soon becoming continuous concentric furrows, dissepiments thin, lamelloid: spores ovoid, smooth, ferruginous.

In publishing the above genus I neglected to state that the name had been previously used by Patouillard for a subgenus of his genus *Xanthochrous* (Ann. Bot. Buitenz. First Suppl. 113. 1897).

Species: *C. Greenei* (Berk.) Murr. *l. c.*

Index to genera

NEW YORK BOTANICAL GARDEN.

Further notes on the orchids of central New York *

HOMER DOLIVER HOUSE

A previous list of the Orchidaceae of central New York † was based mainly upon herbarium specimens examined in the herbarium of Columbia University, the New York Botanical Garden, a lesser number in my own collection and certain records in Paine's catalogue of Oneida County plants (1865). It was evident at the time that the record was a very incomplete one and that several changes in nomenclature were necessary. The purpose of the present paper is to augment the known localities for some of the rarer orchids of that region, the result of further collection and study of specimens in various herbaria, together with authentic reports not previously given, and to make some necessary changes in their nomenclature. In the citations of specimens, N designates the National herbarium; C, Columbia University; Y, New York Botanical Garden; S, Syracuse University; and H, the author's herbarium. Species starred are new to the region and were not given in my previous list.‡

CRIOSANTHES Raf. Am. Monthly Mag. 268. 1818.
Journ. de Phys. **89**: 102. 1819.

This generic segregate of *Cypripedium* was recognized also by Beck in 1833, and Pfitzer recognizes it as a section of *Cypripedium*. Its evident characters are the separate sepals and the prolongation of the lip at the apex into a long blunt spur, which is distorted at the upper end, giving rise to the common name, ram's-head lady's-slipper.

Arietinum Beck, Bot. N. & Middle U. S. 352. 1833.

Arietina, Sect. of *Cypripedium*, Pfitz.; Engl. & Prantl, Planzenfam. **2**^{6}: 83. 1888.

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† Torreya **3**: 49. Ap 1903.

‡ Since the present paper was written, Dr. J. V. Haberer has published in Rhodora (May and June, 1905) some notes on "Plants of Oneida County, New York, and Vicinity," in which records of the following orchids occur: *Achroanthes unifolia*, *Blephariglottis grandiflora*, *Corallorhiza multiflora flavida*, *Peramium tessellatum*, and *Peramium ophioides*.

Criosanthes arietina (R. Br.)

Cypripedium arietinum R. Br.; Ait. Hort Kew. ed. 2, **5**: 222. 1813.

Criosanthes borealis Raf. Am. Monthly Mag. 268. 1818.

Arietinum americanum Beck. Bot. N. & Middle U. S. 352. 1833.

Range: Quebec to Ontario, New York and Minnesota.

ONONDAGA CO.: "Near Syracuse," *Beauchamp*. Cicero Swamp, *House*, 1902, (H). HERKIMER CO., "Mud lake near Jordanville," *Haberer*.

CYPRIPEDIUM L.

Considerable interest attaches to the group of yellow lady's-slippers on account of Dr. P. A. Rydberg's article * which brings up the question as to whether there are three species of yellow-flowered Cypripediums instead of two, as commonly given in recent manuals. An examination of fresh specimens during two seasons since, leads me to believe, "we do have three species of yellow lady's-slippers, one large and one small-flowered, both with vertically flattened lip, and a third . . . one with laterally flattened lip." I must, however, differ somewhat from the accepted treatment of their nomenclature.

CYPRIPEDIUM PUBESCENS Willd. Sp. Pl. **4**: 143. 1805. Hortus Berolinensis **1**: *pl. 13*.

C. bulbosum Mill. Gard. Dict., ed. 8, no. 2. 1768. Not L. 1753.

C. Calceolus Walt. Fl. Car. 222. 1788. Michx. Fl. Bor.-Am. **2**: 161. 1803. Not L. 1753.

C. luteum Ait; Raf. Med. Fl. 140. *pl. 30*. 1828.

C. hirsutum Britton & Brown, Illus. Flora; Britton's Manual and other recent reports, but not Miller, 1768.

This is the common large yellow lady's-slipper, and would bear Miller's name, were that name not antedated by *C. bulbosum* of Linnaeus.

CYPRIPEDIUM PARVIFLORUM Salisb. Trans. Linn. Soc. **1**: 77. *pl. 2. f. 2.* 1791. Also of Gray's Manual, but not of Britton's Manual.

Differs from *C. pubescens*, apparently in size only, and is usually found in more swampy situations than *C. pubescens*. Conservative treatment may reduce this to a variety of *pubescens*.

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* Torreya **2**: 84. Je 1902.

* CYPRIPEDIUM FLAVESCENS DC.; Redouté, Lil. **1**: *pl. 20.* 1802.

C. parviflorum Sims, Bot. Mag. **23**: 911. 1806.—Britton, Manual 291. 1901. Not Salisb.

C. pubescens Sweet, Brit. Flow. Gard. **1**: *pl. 71.* 1823.—A. Gray, Manual. Not Willd.

Distribution: Quebec and New England to Montana and Washington, south in the mountains to West Virginia.

A species of shady ravines and moist rich woodlands, of decidedly more boreal distribution than the last, which seems to follow quite closely the range of *C. pubescens* Willd. In addition to the laterally flattened (the greatest expansion being vertical) lip, the lip is often subglobose and conspicuously ascending, and the leaves narrower and more ascending, than in the other yellow-flowered species of our flora.

CYPRIPEDIUM HIRSUTUM Miller, Gard. Dict. ed. 8, no. 3. 1768

C. reginae Walt. Fl. Car. 222. 1788.—Britton & Brown, Illus. Fl. **1**: 458. 1896.—Britton, Manual, 291. 1901.—Small, Fl. Southeastern U. S. 311. 1903.

C. album Ait. Hort. Kew. **3**: 303. 1789.

C. spectabile Salisb. Trans. Linn. Soc. **1**: *78. pl. 3. f. 3.* 1791. Also of Gray's Manual.

C. canadense Michx. Fl. Bor.-Am. **2**: 161. 1803.

The error of crediting Miller's name *C. hirsutum*, to a yellow-flowered species has been quite prevalent in recent publications. Fox (Bull. Geol. Nat. Hist. Surv. Minn. **9**: 423–449. 1895) uses Miller's name for a yellow-flowered species, but whether the mistake originated with his use of the name is not certain, as he gives no authority for his usage.

In support of the present usage of the name *hirsutum*, I would quote Miller himself: "The third sort [*C. hirsutum*] grows naturally in America where the inhabitants call it the moccasin flower. This rises a foot and a half high. The leaves are of an oblong oval form and are deeply veined. The flower is large, of a reddish brown color, marked with a few purple veins." The height of the plant described precludes its being referred to *C. acaule* Ait. The name moccasin-flower was a name applied to both species and is still so used by country folk, but restricted in recent books to *C. acaule*.

FISSIPES ACAULE (Ait.) Small

Cypripedium acaule Ait.

A form with pure white flowers is reported from Beaver Lake, Onondaga Co., by *Rev. W. M. Beauchamp.*

PERULARIA FLAVA (L.) Rydb.

Apparently not so rare as at first reported. "Frequent in marshes," *Beauchamp.* Near Syracuse, *F. C. Straub*, 1891 (N). Near Oneida, *House*, 1903 (H).

COELOGLOSSUM BRACTEATUM (Willd.) Parl.

ONONDAGA CO.: "Baldwinsville," *Beauchamp.* MADISON CO.: Cazenovia, *M. C. Conner* (S). HERKIMER CO.: *Frank Tweedy*, 1879 (N); near Newport, *House*, 1901 (H).

LYSIAS ORBICULATA (Pursh) Rydb.

ONONDAGA CO.: "Skaneateles Lake," *Beauchamp;* Jamesville, *House*, 1903 (H). ONEIDA CO.: Lee, *Brower* (C); Sylvan Beach, *House*, 1903 (H).

BLEPHARIGLOTTIS BLEPHARIGLOTTIS (Willd.) Rydb.

ONONDAGA CO.: "Abundant at Beaver Lake," *Beauchamp.* HERKIMER CO.: "Frankfort Hill," *Haberer.*

MADISON CO.: Fiddler's Green, *House*, 1905, *no. 1246* (H).

* BLEPHARIGLOTTIS GRANDIFLORA (Bigel.) Rydb.

MADISON CO.: Oneida, *House*, 1903 (H). ONEIDA CO.: swamps west of Fort Bull, Rome, *Paine* (C). HERKIMER CO.: "Northern part of the county," *Calverly* in Paine's Cat. (1865). (*Habenaria fimbriata* A. Gray.)

BLEPHARIGLOTTIS LEUCOPHAEA (Nutt.) Rydb.

ONONDAGA CO.: Marshy meadows near Carpenter's Pond, Fabius, *House*, 1903 (H).

* LIMNORCHIS MAJOR (Lange) Rydb.

This species must be credited to central New York with some doubt; there is a specimen in the Columbia University herbarium, collected by Dr. Asa Gray, locality not indicated, but probably in central New York.

LIMNORCHIS DILATATA LINEARIFOLIA Rydb.

MADISON CO.: Near Chittenango, *House*, 1903 (H).

* LIMNORCHIS MEDIA Rydb.

HERKIMER CO.: Jordanville, *Peck* (Ann. Rep. 20. 1902).

LYSIELLA OBTUSATA (Pursh) Rydb.

ONONDAGA CO.: Carpenter's Pond, Fabius, *House*, 1903 (H).

* PERAMIUM OPHIOIDES (Fernald) Rydb.

ONONDAGA CO.: Green Pond near Jamesville, *House*, 1903 (H).

LIMODORUM TUBEROSUM L.

Forms with pure white flowers reported from Cicero Swamp, Onondaga Co., by Mrs. M. O. Rust.

APLECTRUM

As indicated by Dr. J. H. Barnhart (Torreya **4**: 119–121. Au 1904) the *Aplectrum spicatum* of B.S.P. and of Britton's Manual, should be restored to the former name *A. hyemale* (Willd.) Nutt., and *A. spicatum pallidum* House, becomes *A. hyemale pallidum* (House) Barnhart.

ISOTRIA VERTICILLATA (Willd.) Raf.

ONEIDA CO.: Rome, *J. A. Paine, Jr.* (S). ONONDAGA CO.: Lysander, *O. E. Pearce*, 1885 (N); Kirkville, *House*, 1902 (H). OSWEGO CO.: *C. S. Sheldon*, 1879 (N). MADISON CO.: Fiddler's Green, *House*, 1905, *no. 1248* (H).

POGONIA OPHIOGLOSSOIDES (L.) Ker

ONEIDA CO.: Rome, *Bingham* (S). OSWEGO CO.; North Hannibal, *O. E. Pearce*, 1883 (N). ONONDAGA CO.: Canandaigua, *Mrs. Antisell*, 1881 (N).

TRIPHORA TRIANTHOPHORA (Swartz) Rydb.

ONONDAGA CO.: Kirkville, *Underwood* (S); "Beaver Lake," *Beauchamp; Mrs. M. O. Rust*, 1879 (N).

ARETHUSA BULBOSA L.

ONONDAGA CO.: "Cicero Swamp, Beaver Lake and Labrador Bog," *Beauchamp;* East of Syracuse, *F. Bell* (N); *H. D. House*, 1902 (H).

Achroanthes monophylla (L.) Greene.

Onondaga Co.: "Otisco," *Beauchamp*. Oneida Co.: Bridgewater (C); Taberg, *Peck* (Ann. Rep. 35. 1894).

OPHRYS (Tourn.) L.

Diphyllum Raf. Med. Repos. **5**: 357. 1808; fide Kuntze, Rev. Gen. **2**: 659. 1891.

Listera R. Br.; Ait. Hort. Kew. ed. 2, **5**: 201. 1813. Not *Listera* Adans. 1763.

Distomaea Spenn. Fl. Friburg **1**: 245. 1825.

The following statement regarding the genus *Ophrys* is contributed by Mr. W. F. Wight of the Bureau of Plant Industry, United States Department of Agriculture.

"The genus *Ophrys* as established by Linnaeus in the Species Plantarum (945. 1753) included fifteen species. In the fifth edition of his Genera Plantarum, Linnaeus adopted the genus from Tournefort (Inst. 437. *pl. 250.* 1700) with a slight change in spelling, Tournefort having written it *Ophris.* The five species included by Tournefort were named by Linnaeus in the Species Plantarum *O. ovata*, *O. lilifolia*, *O. ovata β*, *O. paludosa*, and *O. cordata*, respectively. None of these species belongs to *Ophrys* as generally accepted by modern authors, but the name is retained instead for the last Linnaean species, *O. insectifera*, which Tournefort placed not in *Ophris*, but in *Orchis*.

"The type of *Ophrys* must be one of the five original species placed in this genus by Tournefort and cannot be a species which that author placed in *Orchis*. In accordance with the code of nomenclature proposed (1904) by the Botanical Club of the American Association for the Advancement of Science, the type of *Ophrys* is the first Linnaean species included by Tournefort and also figured by him. This species is *Ophrys ovata*, and the retention of this species as the type of the genus *Ophrys* is a treatment which accords with that of several authors among whom the following are noteworthy:

"Scopoli, Flora Carniolica **2**: 205. 1772, restricted *Ophrys* to three species, *O. Nidus-Avis*, *O. ovata* and *O. cordata*, and referred *insectifera* to *Orchis*.

"Hoffmann, Deutschlands Flora 177. 1804, added to Scopoli's species of *Ophrys* a fourth, *O. corallorhiza*, and recognized *Arachnites* published by F. W. Schmidt (Fl. Boem. **1**: 74. 1793) as the name of the genus called *Ophrys* by modern authors.

"TODARO, Nuov. Gen. 12. 1858, discusses the genera *Arachnites* and *Ophrys* and limits the latter to *Ophrys ovata* and its congeners.

"The name *Listera* commonly applied to this genus was published by Robert Brown in 1813 and is a homonym of *Listera* Adanson 1763, proposed for a genus belonging to the family Fabaceae."

The most recent treatment of the genus *Listera* R. Br. is by K. Wiegand (Bull. Torrey Club **26**: 157–171. 1899) where all the known species are described and illustrated. The name *Diphyllum* proposed by Rafinesque in 1808 is taken up by Kuntze for this genus, but Thos. Morong (Bull. Torrey Club **20**: 29. 1893) shows that it can not be referred with any degree of certainty to *Listera* of R. Brown. *Distomaea* Spenner 1825, is based upon *Ophrys cordata*.

The two species previously reported from central New York are:

OPHRYS CORDATA L. Sp. Pl. 946. 1753.

Listera cordata R. Br.; Ait. Hort. Kew. ed. 2, **5**: 201. 1813.
Distomaea cordata Spenn. Fl. Friburg **1**: 245. 1826.

ONONDAGA CO.: Syracuse, *Underwood*, 1889 (C.); "Baldwinsville," *Beauchamp*. MADISON CO.: Fenner, *Underwood* (S). Reported by Paine (1865) from Oneida and Herkimer counties.

✓ **Ophrys australis** (Lindl.) House

Listera australis Lindl. Gen. & Spec. Orch. 456. 1840.

The occurrence of this southern species in central New York is discussed by K. Wiegand in Bull. Torrey Club **26**: 159. 1899.

ONONDAGA CO.: Beaver Lake near Baldwinsville, *Beauchamp* (C), *Underwood, O. E. Pearce*, 1885. OSWEGO CO.: "Lily Marsh," *J. H. Wibbe*, 1876; *C. S. Sheldon*, 1879.

A third species not previously reported is,*

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* Two other species of *Ophrys* are found in the eastern United States:

✓ **Ophrys auriculata** (Wiegand) House

Listera auriculata Wiegand, Bull. Torrey Club **26**: 166. *pl. 356. f. 2.* 1899.

✓ **Ophrys Smallii** (Wiegand) House

Listera reniformis Small, Bull. Torrey Club **24**: 334. 1897. Not G. Don.
Listera Smallii Wiegand, Bull. Torrey Club **26**: 169. *pl. 357. f. 7.* 1899.

* **Ophrys convallarioides** (Swartz) Wight

Epipactis convallarioides, Swartz, Kongl. Vet. Acad. Handl. II. **21**: 232. 1800.

Listera convallarioides Torr. Comp. 320. 1826.

HERKIMER Co.: Cold woods of the higher hills, Newport, *House,* 1903 (H).

IBIDIUM Salisb. Trans. Hort. Soc. **1**: 281. 1812

Aristotelea Lour. Fl. Cochinch. 522. 1790. Not *Aristotela* Adans. 1763.

Gyrostachis Pers. (in text, Syn. **2**: 511. 1807); *Gyrostachys* Kuntze, Rev. Gen. **2**: 664. 1891.

Spiranthes L. C. Richard Mém. Mus. Paris **4**: 42. 1818.

Considerable difference of opinion regarding the generic name of our species of "ladies' tresses" exists among recent American authors. The earliest name, *Orchiastrum* Micheli, is taken up by Professor Greene (Manual Bay Reg. Bot. 305. 1894). Kuntze's usage of the name *Gyrostachys* is followed by Britton & Brown (Illus. Flora **1**: 470. 1896), Britton's Manual (299. 1901) and by Small (Flora Southeastern U. S. 317. 1903), while the name *Spiranthes* L. C. Rich., in usage prior to these authors, is again taken up by Ames (Orch. 113. 1905).

The name *Gyrostachys* is questionably published in text and no combinations are made by Persoon with this name. Regarding three of his species of *Neottia* (*spiralis, aestivalis,* and *tortilis*) Persoon makes this observation after the first:

"Obs. An ob spicam tortilem et labellum crenulatum cum 2-sequentibus, genere distinguenda? (*Gyrostachis*)."

It is quite evident therefore that *Gyrostachis* is not a published genus and under the new code of nomenclature proposed by the Botanical Club of the American Association, cannot be taken up. Were there not an earlier name based upon a well-known species, Richard's name *Spiranthes* (1818) would be the accepted name. The type of *Ibidium* Salisb. (1812) is *I. spirale* Salisb. (*Spiranthes autumnalis* Richard, *S. spiralis* C. Koch), a species congeneric with those of the eastern United States herein treated under the name *Ibidium.*

The following species of *Ibidium* have been reported from central New York, under *Gyrostachys* of my previous list.

Ibidium strictum (Rydb.)

Gyrostachys stricta Rydberg, Fl. Montana 107. 1900. Britton, Manual 299. 1901.

This species, related to the Alaskan *S. Romanzoffiana* Cham., is merged with the latter by Oakes Ames (Orch. 138. 1905).

Ibidium plantagineum (Raf.)

Neottia plantaginea Raf. Am. Monthly Mag. **2**: 206. 1818.
Spiranthes plantaginea Torr. 1843. Not Lindl.
S. latifolia Torr., Lindl. 1840.
Gyrostachys latifolia Kuntze. 1891.
G. plantaginea Britton. 1896.

The commonest species of the genus in central New York, occurring in almost every bog and swampy place.

Ibidium cernuum (L.)

Ophrys cernua L. Sp. Pl. 946. 1753.
Spiranthes cernua Rich. 1817.
Gyrostachys cernua Kuntze. 1891.

Common in sphagnum bogs. Specimens examined from Oneida, Madison, Onondaga and Oswego counties.

* Ibidium ochroleucum (Rydb.)

Gyrostachys ochroleuca Rydb. Britton, Manual 300. 1901.

This species is reduced to a variety of *cernuum* by Oakes Ames (Orch. 145. 1905); central New York specimens, though very rare, are quite distinct from *cernuum.*

ONONDAGA Co.: near Jamesville, *House*, 1903 (H).

Ibidium gracilis (Bigel.)

Neottia gracilis Bigel. Fl. Bost. ed. 2, 322. 1824.
Gyrostachys gracilis Kuntze. 1891.

This is the *Spiranthes gracilis* of Gray's Manual, but probably not of Beck, which seems referable to *S. Beckii* Lindl., although, according to the citations given, Mr. Ames apparently does not hold this view.

Common in sandy places, especially in Oneida County.

Ibidium vernalis (Engelm. & Gray)

Spiranthes vernalis Engelm. & Gray, Bost. Journ. Nat. Hist. **5**: 236. 1845.

Ophrys aestivalis Michx. Not Poir.
Neottia tortilis Muhl.; Barton; Elliott.
S. graminea praecox B.S.P. 1888.
S. praecox Wats. 1890.
S. neglecta Ames. 1904.
"*Gyrostachys praecox* Kuntze;" Britt. & Brown, Illus. Flora **1**: 471. 1896. In part.
Gyrostachys vernalis (Engelm.) Kuntze, 1891; Small, 1903.

Mr. Ames gives the range of this species as Massachusetts to Florida, Kansas, Texas and New Mexico. Collected near Oneida, Madison County, *House*, 1902 (Y). (The *Gyrostachys praecox* of my previous list.)

CYTHEREA Salisb. Trans. Hort. Soc. **1**: 301. 1812

Calypso Salisb. Parad. Lond. *pl. 89.* 1806. Not Thouars, Hist. Veg. Afr. Austr. **1**: 33. *pl. 6.* 1805.

Cytherea bulbosa (L.)

Cypripedium bulbosum L. Sp. Pl. 951. 1753.
Calypso borealis Salisb. Parad. Lond. *pl. 89.* 1806.
Cytherea borealis Salisb. Trans. Hort. Soc. **1**: 301. 1812.
Calypso bulbosa Oakes, Cat. Vermont Pl. 28. 1842.

In proposing a new name (*Cytherea*) for this generic type, Salisbury makes no reference whatever to his previous publication, but it is to be supposed that he did not propose a new name without knowing that his former name was faulty in some respect.

Known in central New York only from "Jordanville, Herkimer Co.," *J. V. Haberer* (N); near Rome, Oneida Co., *Bingham* (S.); and Tamarack Swamp, near Syracuse, Onondaga Co., *House*, 1905, *no. 1109* (H).

The previous list of the *Orchidaceae* of Central New York contained 45 species and 2 varieties. The additions made by the present article bring the number up to a total of 52 species and 2 varieties, besides one species regarding which there can be some doubt as to the authentic crediting to the central New York flora.

UNITED STATES NATIONAL MUSEUM.

The two eastern species of Melica

CHARLES VANCOUVER PIPER

In the United States, east of the Great Plains region, are two species of *Melica* which have long been known as *M. mutica* Walt. and *M. diffusa* Pursh. Their characteristic differences have been well indicated by Scribner, Proc. Acad. Phila. 1885, pp. 40–41.

Empty glumes very unequal and decidedly shorter than the 3- to 5-flowered spikelets; panicle diffusely branched, many-flowered.
M. diffusa.

Empty glumes subequal, nearly as long as the 2-flowered spikelets; panicle few-flowered, sparingly branched below, often reduced to a single raceme.
M. mutica.

These two species, as above distinguished, though very closely allied, have generally been recognized, and no question is here raised as to their validity. A consideration of evidence afforded by the literature pertinent to the problem indicates very clearly, however, that the name *diffusa* does not belong to the plant with which it has so long been associated.

The first binomial description relating to either of our species appears in the first edition of the Species Plantarum as follows:

MELICA.

altissima. 3. MELICA petalis imberbibus, panicula ramosissima. *Hort. ups. 20.*
Melica flosculis glabris; summo urceolari. *Gmel. sib. 1. p. 98. t. 20.*
Gramen avenaceum, locustis rarioribus muticis, virginianum majus. *Moris. hist. 3. p. 216. s. 8. t. 7. f. 51.*
Habitat in Sibiria, Canada. ♃.

Linnaeus here confuses two very distinct plants. The Siberian plant is the true *M. altissima,* while the Virginia plant of Morison is what we now know as *Melica mutica* Walt. The character "panicula ramosissima" may, with some play to the imagination, be applied to the narrow and dense panicle of the Siberian species, but it is wholly inapplicable to the American plant.

Walter, the next writer to touch on the eastern American Melicas, distinguished in his Flora Caroliniana, 1788, as he thought, two species, as follows:

40. MELICA. Cal. 2-valvis, 2-florus. Rudimentum floris inter flosculos.
altissima 1. petalis imberbibus, panicula ramosissima, floribus subacutis.
mutica 2. petalis imberbibus, panicula laxa pauciflora, floribus magnis muticis obtusis.

It will be noticed that Walter copies Linnaeus' description of *M. altissima*, adding two words "floribus subacutis." The types of these two plants of Walter are not now in his herbarium, according to Professor A. S. Hitchcock (Ann. Rep. Mo. Bot. Gard. 47. 1905).

These Walterian species were also unknown to Michaux, who in his Flora **1**: 62. 1803, treats the genus as follows:

MELICA. L.

Gluma 2-valvis, 2-flora. *Cal.* 2-valvis. Inter flosculos rudimentum tertii floris pedunculati.

GLABRA. M. glabra, erecta, panicula erecta, laxa; ramulis simplicibus, paucifloris: floribus nudis, majusculis.:

MORIS., *hist. 3.* sec. 8. t. 7. f. 51.

OBS. Forsan huc referendæ sunt *M. altissima* et *mutica*. WALT.

HAB. a Virginia ad Floridam.

There can be scarcely any doubt that Michaux's plant is what we now call *M. mutica*, but a spikelet in herb. Torrey, said to be from Michaux's type specimen, is *Koeleria cristata*.

Pursh, Fl. Am. Sept. **1**: 77. 1814, distinguishes two species as follows:

90. MELICA. *Gen. pl. 113.*

1. M. panicula laxa pauciflora: ramulis simplicibus, floribus obtusis imberbibus, caule erecto glabro.—*Mich. fl. amer. 1. p. 62.* *glabra.*
   M. mutica. *Walt. fl. car. 78.*
   Icon. *Moris. hist. 3. s. 8. t. 7. f. 51.*
   In shady places. Virginia to Florida. ♃ July. *v. s.*
2. M. panicula diffusa ramosissima, floribus acutis imberbibus, caule erecto pubescente. *diffusa.*
   M. altissima. *Walt. fl. car. 78.*
   In sandy swamps: Virginia and Carolina. ♃ June. *v. s.*

It will be noticed that for the description of *diffusa*, Pursh copies Walter's description of *altissima*, adding the word "diffusa" in describing the panicle, and the phrase "caule erecto pubescente" at the end. An important point, too, lies in the statement that *diffusa* occurs in "Virginia and Carolina," in neither of which states does the plant now referred to *M. diffusa* occur.

Pursh, as is well known, had access to Walter's herbarium, so presumably the abbreviation "v. s." means that he saw Walter's types, not merely that he saw dried specimens, as in all probability he had seen living specimens of one or both, and we would therefore expect the frequently used abbreviation "v. v." if he were referring to his own collections. In any case, Pursh's testimony as to the identity of Walter's species is the only presumably direct evidence we have as to what they really are.

Elliott, Sketch Bot. S. C. and Ga. 154. 1821, recognizes *M. glabra* Michx. and quotes *M. mutica* Walt. as a synonym. He further adds:

"I have from Columbia a variety with the leaves pubescent, the flower evidently smaller, the valves more acute, less membranous at the summit, and handsomely spotted with purple. It is probably the *M. altissima* Walt. but it has scarcely character enough for a distinct species."

Muhlenberg in 1817, Gram. Descr., in treating the eastern Melicas, distinguishes two species — naming both as new — as follows:

XXII. MELICA.

Cal. 2-valvis 2-florus. Rudimentum floris inter flosculos.

1. MELICA SPECIOSA.

Culmo tripedali — quadripedali erecto, nodis glabris.
Foliis lineari-lanceolatis nervosis, subtus pubescentibus.
Ligula bifida.
Vagina nervosa subpubescente.
Panicula secunda.
Ramis paniculae solitariis patulis trifloris, flosculis pedicellatis, pedicello pubescente.
Cal. 2-valvis, valvulis ovato-lanceolatis striatis *obtusis* 2-floris cum rudimento tertii.
Cor. 2-valvis nervosa imberbis, valvula interiore margine pubescente, exteriore glabra.
Stam 3.
Pist. 2, plumosa.
Semen.
Radix ♃.
Habitat in montibus Pennsylvaniae, floret Junio.
Specimen e Virginia culmo inferne purpureo, habet.
Cal. 2-valvis corollae aequalis, valvulis ovatis *acutis* 5-nerviis 2-floris.
Cor. 2-valvis exterior ovata acuta multinervia, interior obtusa margine pubescens.
Neuter flos 2-valvis obtusus, hermaphroditis brevior.

2. MELICA RACEMOSA.

Culmo erecto glabro nodoso basi amethystino, foliato.
Foliis linearibus nervosis scabris.
Ligula abbreviata pilifera subbifida.
Vagina scabra.
Panicula simplici contracta s. racemo 6-flor. terminali, flosculis nutantibus, rachi angulata.
Ramis s. pedunculis *unifloris* solitariis brevibus.
Cal. gluma 2-valvis, valvula una *obtusa*, altera acuta glabra, corolla longior, 2-flora et rudimento tertii.
Cor. gluma 2-valvis, exteriore nervosa majore acuta glabra, altera margine pubescente obtusa.
Stam. 3, alba.
Pist. 2, alba.
Semen ovale flavescens nitidum.
Radix ♃.
Habitat in Carolina, Georgia, nobiscum floret medio Maio.
Habitus *Melicae nutantis*, sed distincta species.

It is interesting to note here that one of Muhlenberg's species has the sheaths pubescent, the other merely scabrous. We have therefore the idea expressed consecutively by Pursh, Elliott and Muhlenberg that the two supposed species are distinguished by a character of pubescence. There is nothing to indicate such a distinction in Walter's descriptions. Michaux's name *glabra* may naturally have suggested prominence to an opposed character. Finally, Pursh may have imbibed his ideas of two species through Muhlenberg, with whom he was intimate, or he may actually have gotten the fact from Walter's types, and Muhlenberg may simply have followed Pursh.

So far as the material in the National Herbarium goes, the plant so long called *M. diffusa* never has pubescent sheaths or leaves, and it seems never to have been found in Virginia or Carolina. The conclusion, therefore, seems unavoidable that the name *diffusa* really belongs to the form of *mutica* with pubescent sheaths; also that it is probably the same as *M. altissima* Walt., as Pursh indicates.

The character of "panicula ramosissima" appears to be clearly a heritage from Linnaeus' original description, rather than a statement of fact. Walter's contrasting characters of "floribis subacutis" and "floribus muticis" are ignored by Pursh, and so far as Atlantic coast specimens are concerned seem to have no real basis.

The synonymy of the eastern Melicas then seems to be as follows:

MELICA MUTICA Walt. Fl. Car. 78. 1788

M. glabra Michx. Fl. Bor.-Am. **1**: 62. 1803.

M. rariflora Schreb. Beschrieb. Gr. **2**: 157. 1810. (This is merely a new name proposed, considered preferable to either *mutica* or *glabra*.)

M. racemosa Muhl. Gram. 88. 1817.

M. Muhlenbergiana Schultes Mant. **2**: 294. 1824. (New name for the above, owing to the older *M. racemosa* Thunb.)

M. mutica glabra A. Gray, Man. Ed. 5, 626. 1867.

MELICA MUTICA DIFFUSA A. Gray, Man. ed. 5, 626. 1867.

M. diffusa Pursh Fl. Am. Sept. **1**: 77. 1814.

M. speciosa Muhl. Gram. 87. 1817.

? *M. altissima* Walt. Fl. Car. 78. 1788.

For the more western plants heretofore considered to be *M. diffusa* Pursh, the only available name is

✓MELICA NITENS Nutt. in herb.

M. diffusa nitens Scribn. Proc. Acad. Nat. Sci. Phila. 1885: 44. 1885.

M. scabra Nutt. Trans. Am. Phil. Soc. **5**: 148. 1837. Not Kunth, 1822.

The types of both these are in the herbarium of the Philadelphia Academy of Sciences. I do not see that *nitens* can be maintained as distinct from the ordinary form of what has been called *M. diffusa*.

BUREAU OF PLANT INDUSTRY,
UNITED STATES DEPARTMENT OF AGRICULTURE.

Crataegus in Berks County, Pennsylvania — III

CALVIN LUTHER GRUBER

This paper on *Crataegus* is designed to include the known species of *Crataegus* of the *punctata* group as found in Berks County, Pa. The following characteristics of the group are either constant or so general that only exceptions will be noted in the descriptions:

Flowers very fragrant, in compound villous-pubescent or tomentose cymes; petals at length reflexed, margins frequently revolute; sepals linear or linear-subulate, entire or sparingly minutely toothed; stamens normally 20; bractlets mostly falling when flowers open, pale-yellow or pinkish; flowering about the third week in May: leaves some form of obovate or spatulate, villous-pubescent or tomentose when young, especially on ribs below; mature leaves more or less villous-pubescent, sometimes glabrate above, villous or tomentose on ribs below; blade entire at base, then serrate or crenate-serrate, and usually doubly serrate or cut-serrate above middle or near apex; glands, when present, small, sessile, drop-like, and whitish or colorless; petiole with shallow, usually wide groove above, taper-margined, frequently reddish or purplish below, the color sometimes extending along midrib for half the length of the blade; ribs impressed above, prominent below: young twigs villous-pubescent or tomentose; lenticels whitish; mature twigs grayish-russet, grayish-green, or brownish-russet: thorns slender to medium, occasionally found tipping a branchlet; trunk and bases of large branches usually beset with several to many long-pronged compound thorns 6–15 cm. long: bark light gray or pale ash-gray toward ends of branches: fruit usually spreading or drooping, 1–several on a cluster, frequently solitary, usually slightly pubescent and concave at base and apex, dark red or light maroon when beginning to color in August, falling mostly after the leaves; sepals usually reflexed or spreading, sometimes broken away, usually on a short neck; cavity deep, 3–4 mm. wide, cupshaped or cylindrical; pedicels moderately to slightly pubescent, 5–20 mm. long; seeds commonly roughish and with 1–3 usually shallow, wide grooves on back; flesh firm, acid or bitterish-acid: branches long, mainly horizontal; usually with a wide, flattened crown.

CRATAEGUS PUNCTATA Jacq.

A few trees of this species are found near Kutztown, Pa. Flowers 16–21 mm. wide, styles 3–5, anthers dark purplish-red or claret; leaves obovate to lance-obovate, frequently cut-serrate near apex; fruit red-maroon, globose, 11–15 mm. long and thick.

CRATAEGUS CROCATA Ashe Ann. Carnegie Museum **1**: 389. 1902

Similar to *C. punctata* and found growing with it; but the anthers frequently are whitish on the sides and the fruit is depresed-globose and pale yellow.

Crataegus punctata mutabilis var. nov.

Flowers 16–21 mm. wide, cymes 3–15-flowered, stamens 18–20, anthers dark purplish-red, styles 3–5: mature leaves sparingly villous-pubescent to glabrate on surface; petiole 1–2.5 cm. long; blade 3–6.5 cm. long, 2–3.5 cm. wide, obovate, lance-obovate, or spatulate, cuneate or narrowly cuneate at base, acute, obtuse, or rounded at apex, entire at base, sometimes nearly to middle, sometimes with a few short lobes near apex, especially on leading shoots, turning pale yellow, mottled with russet, in autumn, and falling mostly about the middle of October: mature twigs villous or glabrate along middle; bark on trunk gray to dark-gray: thorns rather few on branches, 2–4.5 or sometimes 6 or 7 cm. long: fruit red-bronze on one cheek and light to scarlet-bronze on the other or entirely some shade of light bronze, oblong-globose to globose, 13–16 mm. long, 12–15 mm. thick; flesh yellowish; seeds 3–4, 7–8 mm. long, back sometimes without grooves; fruit ripe about the first or second week in October and falling with and after the leaves during the latter half of October and the beginning of November: a small tree attaining a height of 6 m. and a trunk-circumference of 8 dm.

Type two and one-half miles northwest of Kutztown, Pa., in wet ground, near left bank of Sacony Creek.

Crataegus Cydonia sp. nov.

Flowers 19–23 mm. wide, cymes 5–15-flowered, stamens 18–20; anthers rose, becoming purplish-rose; styles 2–5, commonly 3: mature leaves varying from dark-green to yellowish-green on the same tree; petiole 1–1.75 cm. long; blade 3–5 cm. long, 1.75–3.25 cm. wide, at ends of leading shoots sometimes 6–6.5 cm. long and 4–4.5 cm. wide, obovate or oval-obovate, base cuneate, apex usually acute, each rib usually ending in a very short, acute lobe tipped by a narrow tooth, the lobes mostly on the apical third; leaves turning dull-, russet-, or yellowish-bronze or yellow and falling late in October: mature twigs glabrate or sparingly pubescent; bark on trunk dark ash-gray to black-gray: thorns rather abundant, 3–5 or 6.5 cm. long, compound thorns often far out on old branches: fruit solitary or in loose, often long-branched clusters, rich quince-yellow to light-yellow, frequently one side shaded with red-orange, occasionally rich, dark olive-green at apex, punctate with green- or brown-russet, cylindrical-globose or subglobose, 13–20 mm. long and thick; surface usually uneven and apex angular; cavity often elliptical; rarely a few stamens are fleshy and pale-yellow; apex of pedicel frequently surrounded by a fleshy ring; flesh rich yellow, becoming rather soft; seeds 3–4, 7–8 mm. long; fruit ripe about the first or second week in October and falling with and after the leaves late in October: a small tree attaining a height of 6 m. and a trunk-circumference of 6 dm.; old branches usually crowded with short branchlets.

Type about two and one-half miles west of Kutztown, Pa., in a low field.

Crataegus Moselemensis sp. nov.

Flowers 18–22 mm. wide, in 3–15-flowered cymes; stamens 16–20, often as long as the petals; anthers pink, appearing yellow in pollen; styles 2–4, mostly 3: mature leaves dark-green above; petiole .5–1.5 or 2 cm. long; blade 3–5 cm. long, 2–3.5 cm. wide, or on ends of leading shoots often 5–7 cm. long and 4–5 cm. wide, obovate to oval-obovate; base cuneate to acute; apex usually rounded to a short acute point, sometimes broadly rounded; a prominent broader tooth at end of each rib in upper part of blade, often having the appearance of 4–6 pairs of very short lobes, especially on leading shoots: mature twigs often glabrate at middle; bark on trunk gray to dark-gray, somewhat shaggy: thorns few, 1–4 cm. long: fruit rich dark-crimson or light-maroon, punctate with orange or yellow, cylindrical-globose, 16–20 mm. long and thick; sepals subsessile; flesh whitish or yellowish, often reddish-orange at surface; seeds 2–4, 7–9 mm. long, nearly smooth; fruit ripe about the fourth week in September.

Type about one-half mile west of Moselem, Pa., on William Hieter's farm, on high ground, near a large spring; a large, broad-headed tree, 7 m. high, 13.7 m. spread, with a trunk-circumference of 2 m. near ground, 1.83 m. near middle, and 3.25 m. at top of trunk; about 90 years old (1902). This hawthorn was brought to my notice by Mr. Samuel S. Gruber, who also aided me in securing material.

Crataegus Moselemensis corrugata var. nov.

Cymes 5–25-flowered; stamens 18–20, anthers dark-pink; styles 2–5, usually 3: mature leaves rather more villous-pubescent and slightly narrower, obovate to oblong-spatulate, each of the 2–5 pairs of very short lobes crenate and usually with an acute tooth at apex: mature twigs glabrate or sparingly pubescent at base and in the axils of the leaves; bark on trunk ash-gray: thorns rather few, on twigs often yellowish-tipped, 1.5–3 cm. long: fruit scarlet or red, depressed-globose, 12–14 mm. long, 13–15 mm. thick; flesh yellow; seeds 6–7 mm. long; fruit ripe about the second week in October and falling slightly with and after the leaves during the latter half of October: a small tree, attaining a height of 6 m. and a trunk-circumference of 6.5 dm.

Type in North Heidelberg Township, Pa., near Charming Forge, in meadow, on right bank of Tulpehocken Creek.

Crataegus Triosteum sp. nov.

Flowers 19–25 mm. wide, cymes 5–20-flowered, the branches of the cyme sometimes racemose; stamens 19–21; anthers pink or rose, often fading lavender-rose; styles 2–5, often 2, long and slender; sepals usually becoming elongated after petals fall: mature leaves often glabrate but usually tomentose on ribs beneath, somewhat shining, dark-green or dark yellowish-green above, light-green below, rather firm; petiole sometimes tinged with pale brownish-olive at base, 1–2.5 cm. long; blade 5–7.5 cm. long, 2–4, or on ends of leading shoots, 5 cm. wide, broadly oblanceolate, spatulate, narrowly obovate, or on leading shoots obovate; base cuneate, on leading shoots often abruptly so; apex abruptly acute or subacuminate, sometimes obtuse; usually a prominent tooth at end of each rib, frequently with 4–5 pairs of very short lobes above middle, the lobes often rather conspicuous on vigorous shoots; leaves falling about the middle or latter half of October, those on fruiting branchlets early in October; glands often clustered on stipules: young twigs sparingly to moderately loosely pilose; mature twigs glabrate or slightly pubescent at base; bark on trunk dark ash-gray, scales weak: thorns moderately numerous, 3–7 cm. long, usually slightly reflexed and curved: fruit in loose, long-branched clusters, globose to oblong-globose, 13–16 mm. long and thick; when fully ripe, orange-cardinal or cardinal, apex sometimes rich dark-green, usually much punctate with russet, generally rounded; sepals usually prominent and long, spreading-recurved to ascending, often waving, remaining green for a long time; flesh yellow; seeds 3–5, 8–9 mm. long, placed subcentrally; fruit ripe about the first or second week in October and falling with and after the leaves; trees in dry soil usually have redder and smaller fruit with less conspicuous sepals: a sturdy, small tree, trunk often well defined nearly to the top, with numerous ascending branches or the upper ones horizontal, attaining a a height of 3–6 m. and a trunk-circumference of 4–6 dm.

On banks of streams and also on high gravelly soil.

Type on left bank of Moselem Creek, near Moselem, Pa.

KUTZTOWN, PENNSYLVANIA.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Arechavaleta, J. Nueva contribución al conocimiento de la flora del Uruguay. Anal. Mus. Nac. Montevideo II. **1**: 4–16. *pl. 1–8.* 1904.

Descriptions of new species in *Eupatorium*, *Mikania*, *Senecio*, *Mutisia*, *Chaptalia*, and *Trixis* (2).

Autran, E. Note sur le Caá-éhé. Revista Farmac. **44**: 70–74, 105–111. 1904.

With a reprint of the original description of this plant, *Eupatorium Rebaudianum* M. S. Bertoni, Revista Agron. Asunción, 1899.

Autran, E. Sur le *Tropaeolum patagonicum* Speg. Revista Farmac. **44**: 37–41. 1904.

Beal, W. J. Michigan flora: a list of the fern and seed plants growing without cultivation. Rep. Mich. Acad. Sci. **5**: (1–147). 1904.

Berger, A. *Echinocereus acifer* Lemaire. Gard. Chron. III. **36**: 245. *f. 100.* 1 O 1904.

Native of Mexico.

Berger, A. *Opuntia stenopetala* Eng. Monats. Kakteenk. **14**: 171, 172. *f. 1, 2.* 15 N 1904.

Brown, N. E. *Anthurium pendulifolium.* Gard. Chron. III. 36: 362. 26 N 1904.

A new species, supposed to be native of Colombia.

Cockerell, T. D. A. Botanical nomenclature. Nature **70**: 318, 319. 4 Au 1904.

Cockerell, T. D. A. The roses of Pecos, New Mexico. Proc. Acad. Nat. Sci. Phila. **56**: 108–112. 2 Mr 1904; 113–118. 7 Mr 1904.

Cogniaux, A. *Orchidaceae* — VIII. Flora Bras. **12⁶**: 1–202. *pl. 1–42.* 15 F 1904.

The beginning of the third volume devoted to *Orchidaceae.* There are new species in *Maxillaria* (2), *Ornithidium, Warmingia, Notylia* (3), and *Centroglossa.*

Cufino, L. Pugillus cryptogamarum canadensium. Malpighia **18**: 559–562. 1904.

Daguillon, A. & Coupin, H. Observations sur la structure des glandes pétiolaires d'*Hevea brasiliensis.* Rev. Gén. Bot. **16**: 81–90. *f. 13–15.* 15 Mr 1904.

Dammer, U. The species of *Chamaedorea* with simple leaves. Gard. Chron. III. **36**: 202. 17 S 1904; 245, 246. 1 O 1904.

With descriptions of 6 new species, natives of Mexico, Costa Rica, and Peru.

Dams, E. *Echinocactus cataphractus* n. sp. Monats. Kakteenk. **14**: 172. 173. 15 N 1904.

Probably native of Paraguay.

Dams, E. *Echinocactus Wislizeni* Eng. Monats. Kakteenk. **14**: 184, 185. 15 D 1904. [Illust.]

Dams, E. Formen des *Echinocactus capricornus* Dietr. Monats. Kakteenk. **14**: 183, 184. 15 D 1904. [Illust.]

Dams, E. Eine Sammelreise in Arizona. Monats. Kakteenk. **14**: 179–182. 15 D 1904.

Dominguez, J. A. Note sur deux gommes de la République Argentine. Revista Farmac. **44**: 5–11, 35–37. 1904.

Drummond, A. T. Origin of plants common to Europe and America. Nature **70**: 55. 19 My 1904.

Harshberger, J. W. The comparative age of the different floristic elements of eastern North America. Proc. Acad. Nat. Sci. Phila. **56**: 601–615. 19 O 1904.

Hartman, E. *Cereus Weingartianus.* Monats. Kakteenk. **14**: 155. 15 O 1904. [Illust.]

A new species, native of Haiti.

Hicken, C. M. Doctor Rodulfo Amando Philippi: breves apuntes biográficos. Anal. Soc. Cient. Argent. **58**: 145–151. *portrait.* O 1904.

Keller, I. A. Summer activity of some spring flowers. Proc. Acad. Nat. Sci. Phila. **56**: 481–483. 23 Jl 1904.

Kremers, E. The study of phytochemistry. Pharm. Rev. **22**: 394–396. O 1904; 462–466. D 1904.

Lloyd, C. G. Mycological notes. **16**: 157–172. Mr 1904; **17**: 173–188. *f. 71–77.* Je 1904; **18**: 189–204. *pl. 17–24 + f. 78–82.* Jl 1904.

Lloyd, J. U. The founding of the Lloyd Library. Pharm. Rev. **22**: 357–361. O 1904.

McFarland, J. H. Getting acquainted with the trees. i–xi. 1–241. New York, [Ap] 1904. [Illust.]

Metcalf, M. M. An outline of organic evolution. i–xxii. 1–204. *pl. 1–101 + f. 1–46.* New York, 1904.

Niles, G. G. Bog-trotting for orchids. i–xvi. 1–310. New York, [Ap] 1904. [Illust.]

Pennington, M. S. Medicina popular en las islas del Delta del Rio Paraná. 1–11. Buenos Aires, 1904.

Rick, J. Fungos do Rio Grande do Sul (Brazil). Brotéria **3**: 276–293. 1904.

Includes descriptions of 4 new species in as many genera.

Robertson, A. Spore-formation in *Torreya californica.* New Phytol. **3**: 133–148. *pl. 3, 4.* 27 Jl 1904.

Robertson, A. Studies in the morphology of *Torreya californica* Torrey. II. The sexual organs and fertilization. New Phytol. **3**: 205–216. *pl. 7–9.* 20 D 1904.

Rolfe, R. A. *Cochlioda brasiliensis.* Gard. Chron. III. **36**: 141. 27 Au 1904.

A new species, native of Brazil.

Schaffner, J. H., Jennings, O. E., & Tyler, F. J. Ecological study of Brush Lake. Proc. Ohio Acad. Sci. **4**: 151–165. *f. 1, 2.* 1 D 1904.

Seaver, F. J. The *Discomycetes* of eastern Iowa. Bull. Lab. Nat. Hist. State Univ. Iowa **5**: 230–297. *pl. 1–25.* N 1904.

Shaw, G. R. The pines of Cuba. [1–3.] [1904.] [Illust.]

Reprinted, with changes, from Gard. Chron. III. **35**: 179, 180.

Shaw, G. R. The pines of western Cuba. Gard. Chron. III. **36**: 98. 6 Au 1904.

Shaw, G. R. The pines of western Cuba. [1–3.] [1904.]

Reprinted, with additional note, from Gard. Chron. III. **36**: 98.

Shaw, G. R. *Pinus leiophylla.* Gard. Chron. III. **36**: 175. *f. 69.* 3 S 1904.

Native of Mexico.

Shaw, G. R. *Pinus Nelsoni.* Gard. Chron. III. **36**: 122. *f. 49.* 20 Au 1904.
A new species, native of Mexico.

Shimek, B. The flora of the St. Peter sandstone in Winnishiek County, Iowa. Bull. Lab. Nat. Hist. State Univ. Iowa **5**: 225–229. N 1904.

Sprague, T. A. The cultivated species of *Manettia.* Gard. Chron. III. **36**: 384, 385. *f. 169.* 3 D 1904.
Includes a description of *M. inflata* sp. nov., native of Brazil.

Sprague, T. A. *Lobelia heterodonta.* Gard. Chron. III. **36**: 252, 253. 8 O 1904.
A new species, native of Grenada, West Indies.

Urbina, M. Plantas comestibles de los antiguos Mexicanos. Anal. Mus. Nac. Mexico II. **1**: 503–591. 1904.

Weingart, W. *Cereus Kunthianus* Otto. Monats. Kakteenk. **14**: 147–150. 15 O 1904.

Weingart, W. *Peireskia undulata* Lem. Monats. Kakteenk. **14**: 187–189. 15 D 1904.

Wenzell, W. T. On "abietene." Pharm. Rev. **22**: 408–414. N 1904. [Illust.]

Wildeman, E. de. *Stelis Binoti.* Gard. Chron. III. **36**: 381. 3 D 1904.
A new species, native of Brazil.

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AUGUST, 1905

On the transpiration of Fouquieria splendens*

William Austin Cannon

The present paper is an account of one of several studies which were carried on in 1904 by the polymeter method upon plants in place. It will not be necessary to give here a description of the method, since this will soon be done elsewhere,† but a certain peculiarity attending its use may be briefly referred to. By the new hygrometric method it is possible to study the transpiration of a plant in the field not only once, but many times, without injury to it. The fact that repeated observations of transpiration can be made rendered it possible to learn not only the daily but the seasonal rate as well. Thus a transpiration history, not indeed without many gaps, has been traced. The experiments were begun in February and were continued from time to time until after the rains of summer were over.

In addition to the transpiration observations, and in connection with them, certain environmental factors were observed and measured and a comparison was made between them and the rate of transpiration. This part of the work was from necessity secondary, but despite this enough was done to establish certain important facts and to indicate lines of study which may be profitably followed in the future.

The difficulty in tracing the influence of external conditions on the rate lies, among other things, in the changeableness of these

* Papers from the Desert Botanical Laboratory of the Carnegie Institution, No. 10.

† Cannon, W. A. A new method of measuring the transpiration of plants in place. Annals of Botany, *ined.*

[The Bulletin for July (**32** : 337–396) was issued 29 Jl 1905.]

factors from day to day. For outdoor work, therefore, where the conditions cannot be controlled beyond a certain limit, it is a great advantage when the climatic factors vary in a uniform manner, or when certain conditions are so pronounced that their influence is unmistakable. The year 1904 was an especially fortunate one for field work because, as will be shown below, uniform variations in the temperature of the air, in humidity and in other climatic features were maintained for days together, and the uniformity of the environmental factors made the outdoor work similar in this regard to that done in the laboratory where the conditions of experiments are to a degree under control.

Apparently the main cause of the uniformity of the climate in 1904 was the small rainfall of the year. At the same time the most disturbing feature of the uniformity was the sudden and infrequent rains. Since the rain is an all-important factor in the biology of desert plants, it consequently happens that the history of their transpiration reflects most clearly the influence of rain and of drought, so that the relation of transpiration to these features constitutes the key-note of the studies. For this reason it is best before presenting an account of the experiments to give an outline record of the climate for the year, in which emphasis is placed on the humidity of the air and on the rainfall.

CLIMATE FOR 1904

The normal rainfall at Tucson, the average for 15 years, is 11.74 inches.* In 1904 the total precipitation was 7.79,† or about 75 per cent. normal.

The distribution of the rains throughout the year, both the usual distribution and that for 1904, is shown in FIGURE 1. It will be observed from the figure that the winter rains of the year were very light, but the summer rains, particularly those of August, were slightly greater than usual. This distribution operated therefore to intensify the dryness of that portion of the year when the plants are naturally least active, and at the same time to bring about unusually favorable vegetative conditions at the season of the greatest activity, that is, in summer.

* Coville, F. V., & MacDougal, D. T. Desert Botanical Laboratory of the Carnegie Institution, 26. 1903.

† From data provided by the University of Arizona.

The significance of the small rainfall of the year is a factor which must be taken into account, and, although it seems difficult to express this concretely, it may be better appreciated if we consider the relation of the precipitation of the year to the possible total evaporation. The normal annual evaporation at Tucson is estimated to be 90 inches.* The ratio between the normal annual rainfall and the evaporation is therefore 1 : 7.7. If we suppose for the moment that the decrease in 1904 of approximately 25

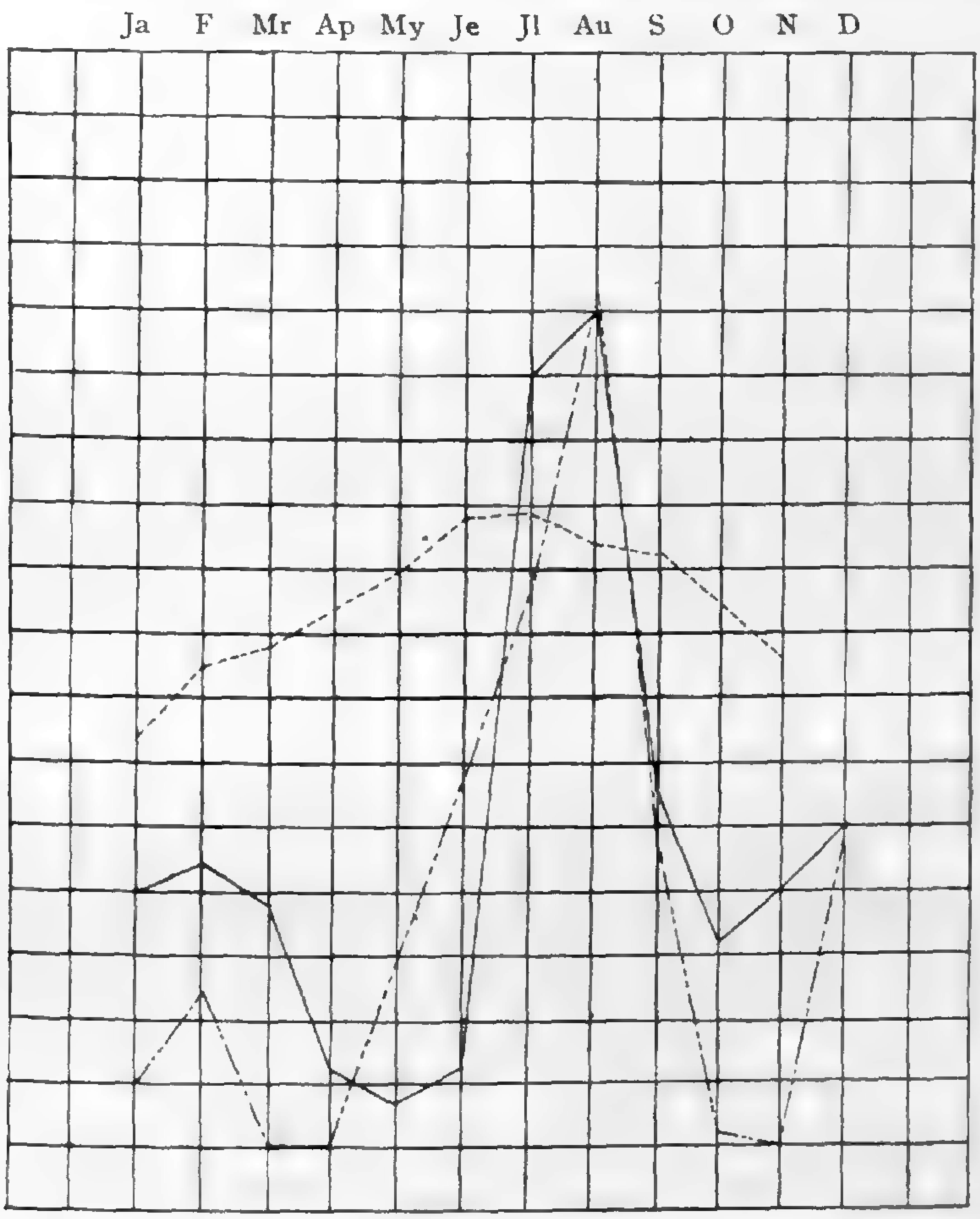

FIGURE 1. The rainfall and the mean maximum temperature at Tucson. The normal rainfall is represented by a solid line; the rainfall in 1904 by a broken one (- - — - -); 5 mm. = one-half inch precipitation. The mean maximum temperature for the year is given by the second broken line (- - - - -); 5 mm. = 10 degrees Fahrenheit.

per cent. in the precipitation was accompanied by a proportional increase in the evaporation for the year, the ratio would be greatly altered. An increase of 25 per cent. in the total evaporation would make 112.5 inches; and the ratio between precipitation and evaporation becomes 1 : 12.7.

* Coville & MacDougal, *l. c.* 27.

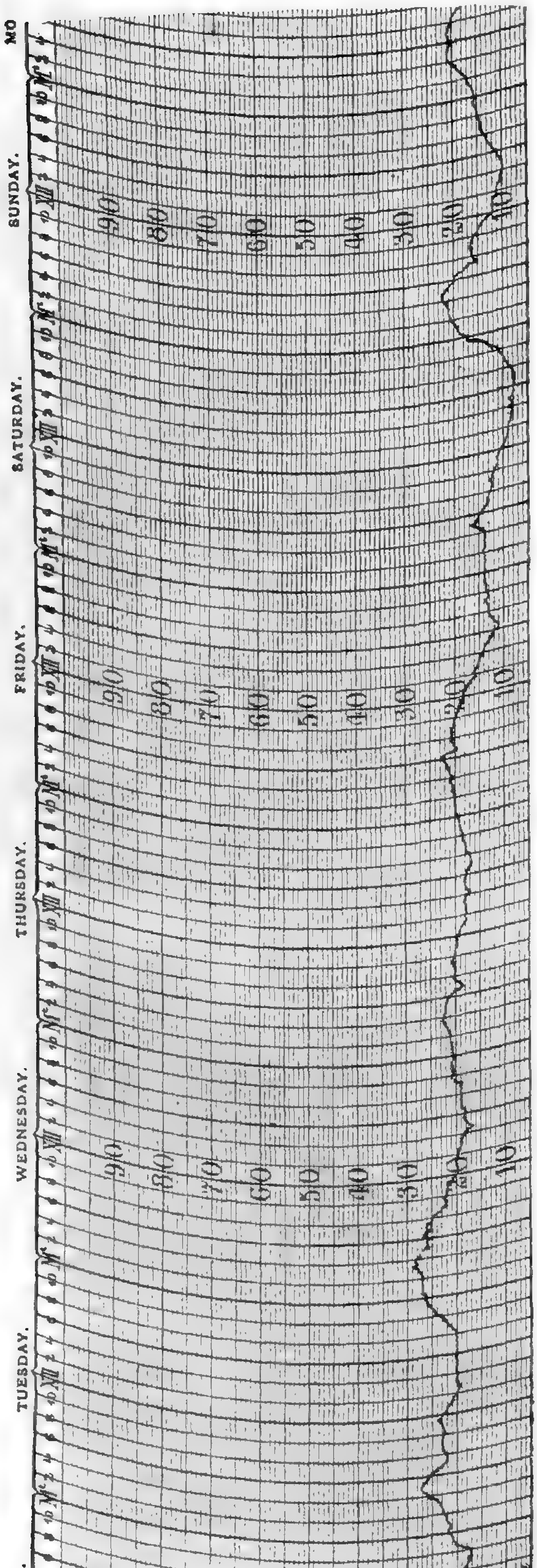

FIGURE 2. Hygrographic record for the week ending July 4.

Whether the amount of evaporation for 1904 and the relation of that amount to the rainfall of the year as given are exact expressions of the true ratio and of the actual amount does not matter for the present — the striking fact, which is inadequately shown by the illustration, is that a really small decrease in the annual rainfall may be a most important fact in the nicely balanced life relations of desert plants.

A climatic condition, the relative humidity, which is closely associated with the rainfall and thus with the rate of transpiration, may be passed over in few words. As the seasonal rainfall was less than usual, so also the average relative humidity was probably correspondingly lower. What the departure from the normal may have been, however, I have no observations at hand to show. Certain it is that the humidity at times was very low, as for instance during the entire week ending July 4 it did not even at night-time exceed 28 per cent. In the daytime it was always low (FIGURE 2).

A certain peculiarity of the changes in the relative humidity, which may have to be taken into account when the biological significance of the absorption of water by the aerial parts is considered, may be pointed out. I refer to the fall of the humidity which ordinarily occurs soon after a storm has passed. This is illustrated in FIGURE 3. On Wednesday night, Thursday and Thursday night a small rainfall (.04 in.) occurred. During the rain the humidity was rather high even in the laboratory where the hygrograph was placed, but within twelve hours after it ceased the humidity was nearly as low again as previous to the storm.

The humidity remains high, however, for several days following a long storm, and since the most rain ordinarily falls in summer this peculiarity cannot fail to be of great importance to the desert plants.

As regards the temperature it will not be necessary for the present purpose to go into this phase of the climate of the year more than to mention certain striking characteristics.

The annual as well as the daily range was relatively large. During the driest portion of the summer, in June, the maximum for the year, 107° F., was recorded. The temperatures were somewhat lower after the rains of summer had come. (See FIGURE 1, which shows the mean maximum temperature for 1904.) In the colder part of the year, December to March, the thermometer reached the freezing point or below each month, and in January a temperature of 15° F., which was the minimum for the year, was reported. The range of temperature for the year was therefore 92° F.

Fifty degrees Fahrenheit was the greatest daily range. This was recorded in April in the midst of a rainless period. In August, on the other hand, during the summer rains, a daily range of but 31° F. was noted — this was the least of the year.

FOUQUIERIA SPLENDENS

Fouquieria splendens, "ocotillo" of the native Mexicans, is one of the most striking desert shrubs. It is well adapted, not only in the mature condition but as a seedling as well, to endure

FIGURE 3. Hygrographic record for the week ending June 20. The figure shows a characteristic rise in humidity during a sudden storm and a characteristic fall after the storm has passed. In this instance the rain (.04 in.) occurred on Wednesday, at night, and on Thursday.

droughts apparently the most extreme, and it flourishes in habitats which are so dry as to be unfit for many desert plants.

A characteristic specimen of ocotillo is composed of a number (a dozen or more) of fairly straight branches, for the most part simple, which arise from the short main stem near the ground (FIGURE 4). The branches are from 2 to 5 meters in length, and bear spines which are regularly placed and which are morphologically midribs of the primary leaves.

During the dry seasons the branches are naked, but in the

FIGURE 4. *Fouquieria splendens* in leaf.

rainy ones they are well covered with rosettes of small leaves which are borne in the axils of the spines. The variation in the foliage is not a seasonal phenomenon but is directly associated with the distribution of the rainfall. Although seemingly lifeless during the droughts the plant is not dormant, since beneath its gray exterior there is chlorophyl-bearing tissue which enables the photosynthetic processes to go on, even if in a feeble manner, and consequently some transpiration may always be detected. When the rains return new leaves are formed with a promptness that is surprising, and this phase of the plant's history constitutes one of the most admirable of adaptations to desert conditions.

RECORD OF EXPERIMENTS

All of the experiments on *Fouquieria* which are reported in this paper, but which constitute a part only of those performed, were conducted with the polymeter method of determining transpiration already mentioned,* and all were conducted upon plants or branches in place. It will only be necessary for the sake of clearness to point out the significance of the figures under the heading "Amount in milligrams." In each instance the first number refers to the amount of moisture present in the bell-glass, which encloses the plant, at the beginning of the experiment; the second number is the amount of moisture in the bell-glass at the end of the experiment. The difference between the two numbers constitutes of course the amount transpired in the time expressed in the first column.

TRANSPIRATION OF FOUQUIERIA NO. I. EXPERIMENTS 1–6

Fouquieria No. I is growing about 150 meters south of the laboratory building. It has half a dozen branches and is about one-half a meter high. The first three experiments were performed when the plant was leafless, because of the severe drought; leaves were present in the other experiments.

Experiment No. 1, February 12: Transpiration of leafless stems

The following data were derived from this experiment:

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
10:30	23.5	78° F.	65
12:30	27	81	68.5

Experiment No. 2, February 15: The same

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
11:40	28.5	77° F.	63.7
1:40	31	79	73.7

The rate of transpiration in Experiment No. 1 is 1.85 milligrams per hour; that in the succeeding experiment is 5 milligrams per hour.

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* Cannon, *l. c.*

A slight rain, not enough to induce the formation of leaves, was recorded previous to the 12th. From subsequent experiments on the influence of the rains on transpiration it was observed that the rate may be increased without a change in the extent of the transpiring surface, and it is possible that the small but positive change in the rate which was recorded in Experiment No. 2 is directly traceable to the earlier rain.

In the experiments on the naked stems of *Fouquieria* it was suspected that the hygrometric method did not reveal the true condition of affairs inasmuch as it did not show how much of the moisture which had been evolved from the plant was subsequently absorbed by the dry branches. The affinity of air-dry stems of *Fouquieria* for atmospheric moisture had been demonstrated in the laboratory in the following manner: Leafless branches were removed from the plant, the cut end was coated with vaseline and the branch was placed in a beaker containing about two centimeters of water. The water very promptly ascended for several centimeters the surface layers of the branch, which also increased considerably in weight. The same behavior of leafless stems was also observed outdoors. In every instance the portion of the stem which had the affinity for water was the *younger* portion. Later the outer cortical part of the branches is infiltrated with a waxy substance which is impervious to water. To learn whether air-dry stems would absorb water-vapor also the succeeding experiment was devised.

Experiment No. 3, February 16: Absorption of hygroscopic moisture

The apparatus was set up in the same manner as if to determine the transpiration but with the addition of an arrangement by which air charged heavily with vapor was made to pass into the bell-glass. As soon as the humidity of the air of the bell was increased sufficiently, the openings into it were tightly closed and the reading of the polymeter was taken. The following is a brief of the experiment.

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
10:25	65	83° F.	176
11:15	53.5	88	168.7

In 50 minutes the stems absorbed 7.3 milligrams of moisture.

Although this experiment and others not reported indicate that under certain conditions leafless branches of *Fouquieria* can and in fact do absorb appreciable amounts of water and of water-vapor, they do not show that the water or the vapor is of physiological significance. Whether such is true I have not been able to demonstrate; since all the evidence thus far accumulated is negative.

Experiments 4–6: Effect of rains

The immediate effect of rains upon the rate of transpiration was repeatedly observed. When they resulted in an actual increase in the water-supply of the plant, the rate became greater, and later, as the available water-supply was decreased, the rate of transpiration became smaller. This was shown by the experiments on February 24 and March 4, 10, and 17, when leaves were developing, when they were mature, and when they may be termed senile. The rates for these experiments were respectively 47.5, 120, 24.4, and 13.7 milligrams per hour.

The intimate connection of the rate with the rains is also shown, and more strikingly, in the experiments which were performed soon after the rains of May. Between the experiments which were carried on during the latter part of March and those of May the plant was defoliated on account of the continuation of the drought. The rains of May were distributed as follows: May 10, .47 in.; May 11, .75 in. (the latter fell between 1:40 and 2:15 P.M.); May 12, .02 in. and May 16, .06 in. As a result of this sudden and considerable rainfall the mountain upon which the Desert Botanical Laboratory is situated, which had been very dry all winter, was thoroughly wet, and the mesa between it and the Santa Cruz River was covered with water. This rain had a very marked effect upon all vegetation. Trees and shrubs which had been without leaves all winter put out leaves promptly, the cacti which had become badly shriveled from loss of water directly became plump, but perhaps the most noticeable response was given by the fouquierias. Up to the time of this storm *Fouquieria* No. I and other ocotillos were leafless. On Friday, May 13, 48 hours after the heaviest fall of rain, *Fouquieria* No. I was rapidly coming into leaf, and by the afternoon of the following day these were of nearly mature size. The three succeeding experiments were performed Friday, Saturday and Monday — May 13, 14, and 16 — and they illustrate how promptly the plant availed itself of the more favorable water-supply.

Experiment No. 4, May 13

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
2:55	33.5	93°F.	122.5
3:05	49	93	180

The rate is 345 milligrams per hour.

Experiment No. 5, May 14

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
9:48	30	91°F.	103.7
9:56	66.5	94	231.2

The rate is 956.2 milligrams per hour.

Experiment No. 6, May 16

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
9:15	25	92°F.	88.7
9:20	66.5	93	245

The rate is 1875.6 milligrams per hour.

Summary of experiments on Fouquieria No. 1

			Transpiration in milligrams per hour.
February	12	(without leaves)	1.8
"	15	"	5
"	24	(in leaf)	47.5
March	4	"	120
"	10	"	24.4
"	17	"	13.7
May	13	"	345
"	14	"	956.2
"	16	"	1875.6

TRANSPIRATION OF FOUQUIERIA NO. II. EXPERIMENTS 7–9

Fouquieria No. II, which is growing nearly north of the laboratory and a little lower on the mountain, is about the size of *Fouquieria* No. I. The character of the plant and the general nature of the habitat are indicated by FIGURES 5 and 6, and do not require further comment.

Experiment No. 7, March 22: Effects of irrigation

At this time the leaves of *Fouquieria* No. II, as of others on the mountain (see Effect of rains, page 406), had been nearly all discarded and most of those which remained were yellowish or

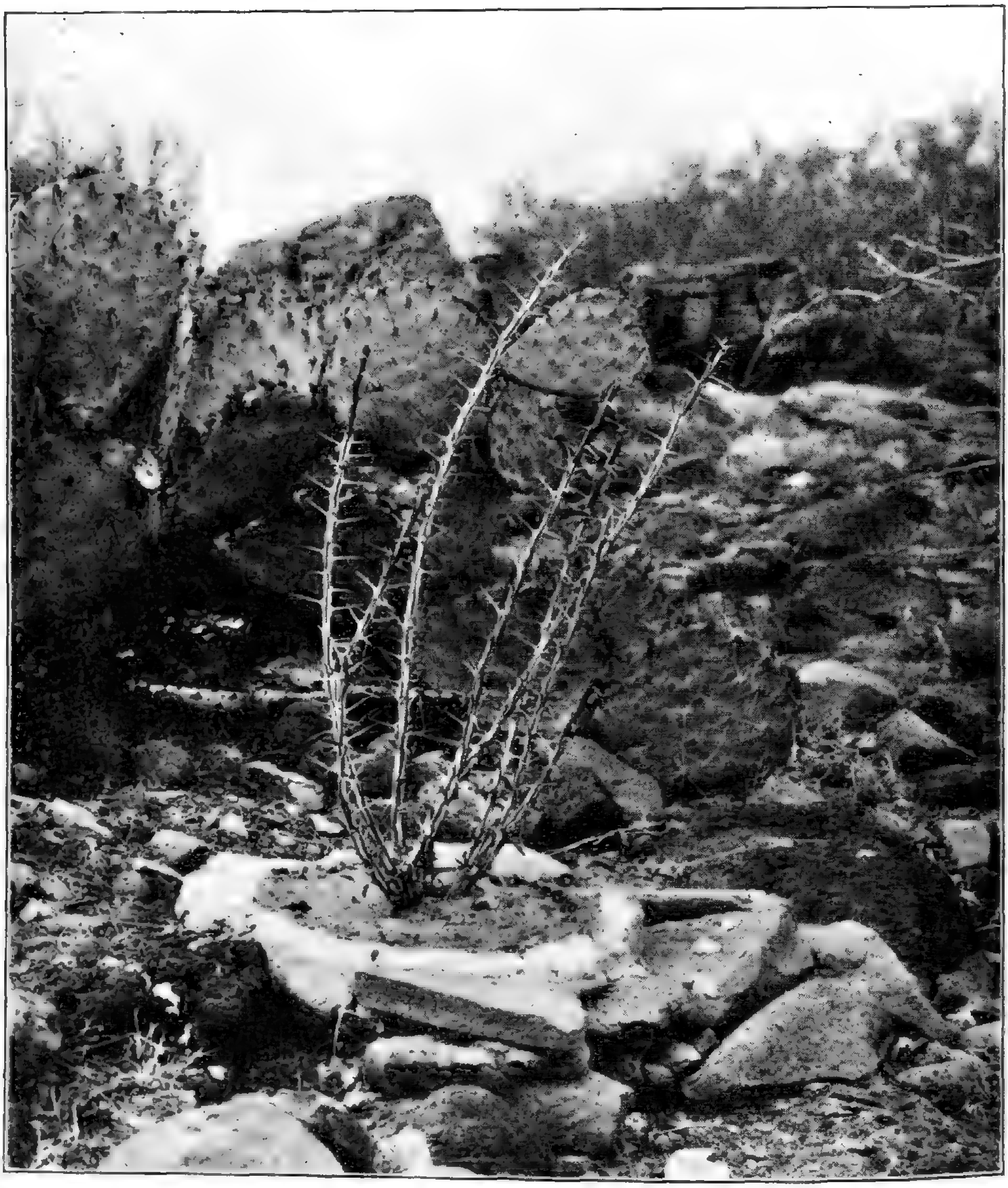

FIGURE 5. *Fouquieria* No. II, March 26.

partly withered and plainly indicated the harmful effects of the prolonged drought. The rate of transpiration was also very small, as the data of an experiment taken in the midst of the dry time shows.

The following data were derived from an experiment which was conducted before water was given the plant.

Time.	Per cent of saturation.	Tem rature.	Amount in milligrams.
1:30	55	80° F.	208.7
2:30	68	79	323.7

The rate of transpiration is .22 milligrams per minute for 100 sq. cm. of leaf surface, or 115 milligrams per hour for the entire plant.

FIGURE 6. *Fouquieria* No. II., April 8. This plant was without leaves, March 26 (*Figure 5*); it was given water March 26 and March 28 and was in leaf April 4.

Experiment No. 8, April 5: The same

To watch the reaction of the plant to an increase in the water-supply, at a time when it was suffering from an insufficient supply,

FIGURE 7. Daily periodicity in *Fouquieria*. *A* = temperature of air in degrees Centigrade. *B* = relative humidity, taken before each experiment. *C* = transpiration calculated to hourly periods, each space representing 100 milligrams. The time of each reading is given.

on March 26 and 28 about 20 gallons were put slowly on the ground at its base. As a result leaves were put out very promptly and the total transpiration was increased many fold.

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
10:03	28	26° C.	133.7
10:13	72	27	382.5

The rate of transpiration is 1492.8 milligrams per hour for the entire plant.

The history of the leaf-covering of *Fouquieria* No. II from February to August is of interest. The plant was seen to be in leaf the latter part of February, but as a result of the long drought in March the leaves fell away, so that the foliage which the plant formed the first part of April after it had been irrigated (Experiment No. 8) was the second leaf-covering of the year. April was a dry month and the plant was again defoliated. The drought was broken by a rain about the middle of May and *Fouquieria* No. II came into leaf for the third time. With the advent of dry and hot weather in June the leaves fell away again. On June 29 three gallons of water were poured slowly on the ground at the base of the plant. Leaf-buds were observed July 1, and at 2 P. M. on the succeeding day they were 1 cm. long. On the fifth the leaves were of mature size. (Compare FIGURE 6.) The leaves which were formed at this time, during an extremely dry season (FIGURE 2), soon withered and the plant was defoliated the fourth time. It is of interest to note that with the coming of the summer rains still another leaf-covering appeared on the plant, and therefore, it happened that *Fouquieria* No. II came into leaf five separate times between February and August, and that the exciting cause in each instance was an increase in the available water-supply.

Experiment No. 9, April 6 and 7: Daily periodicity

On the morning of April 6, at 9:53, the rate of transpiration of *Fouquieria* No. II was taken and it was observed at hourly intervals throughout the day until 8:52 P. M. The experiment was continued the following morning at 4:32 and readings were made every hour until 8:20 A. M. The record of transpiration was complete for the daytime and for a portion of the night. A summary of the experiment is presented in FIGURE 7.

It will be noticed that the curve of transpiration reaches its highest point about noon and that in a general way it is similar to the curve expressing the temperature and that it opposes that representing the relative humidity. However, it neither closely follows the one nor flatly opposes the other. The maximum transpiration precedes the highest temperature of the day and a marked decline in the rate of transpiration takes place while the high temperature is maintained. The opposition of the curves representing the relative humidity and the transpiration is more consistent, but even in this case the afternoon decrease in the rate is more rapid than the rise in the relative humidity. It would be of much interest to compare the periodicity with the daily variation of other factors, as the temperature of the ground, and particularly the daily variation of the light, but unfortunately no data were available at the time to make this possible.

EXPERIMENT NO. 10, AUGUST 26: MAXIMUM RATE

As graphically shown in FIGURE 1, the heaviest rain of the year occurred in midsummer at a time when the temperature also was high. Although the rains did not extend over a period exceeding six weeks, the face of the desert was wholly changed because of them. Annuals in great variety and in large numbers appeared on previously barren stretches, and shrubs and trees which were apparently dormant during the droughts became covered with an abundance of large leaves. Thus the summer vegetation which appeared in consequence of the rains was tropical in its luxuriance. It was with much interest, therefore, that I observed the transpiration of plants at this period.

The following data were obtained about the close of the rainy period from the study of a branch in place:

Time.	Per cent. of saturation.	Temperature.	Amount in milligrams.
1:10 P. M.	33	98° F.	263.7
1:24	58.5	103	540

The rate of transpiration is 8.25 milligrams per minute for 100 sq. cm. of leaf surface. This is the highest rate observed for *Fouquieria* at any time during the year.

SUMMARY AND CONCLUSIONS

The leading points in this paper together with the conclusions may be briefly stated as follows:

1. The noteworthy feature of the climate of 1904 was the small precipitation, which was 75 per cent. normal. The rainfall was so distributed that little of it occurred in winter, spring or early summer, most of it coming in midsummer. Thus during most of the year the conditions of plant life were very severe; but in August especially they were favorable to plant growth.

2. The customary fleeting vegetation of late winter and of spring, composed mainly of annuals, did not appear, and the larger and long-lived forms either did not put on leaves at the time at all, or if they did so they were dropped when droughts returned. In summer, however, all vegetation was very luxuriant.

3. Although without leaves during periods of drouth *Fouquieria* nevertheless maintains at such times a feeble rate of transpiration.

4. Air-dry stems of *Fouquieria* in place can absorb hygroscopic moisture in appreciable amounts.

5. The rate of transpiration of *Fouquieria*, and of other shrubs, varied directly with the water-supply. The rate increased as an immediate effect of the rains and it decreased as the time past the rains became greater. Accompanying the increase in rate there was always an increase in the transpiring surface (although the rate may increase without the latter), but a decrease in the rate occurred without an immediate and corresponding decrease in the transpiring surface, although in the end this always became less.

6. The least rate of transpiration, when leaves were present, was observed during the dry and cool period the latter part of March. At this time a rate of .22 milligram per minute for 100 sq. cm. of leaf surface was recorded. The highest rate was observed August 26, near the close of the summer rains when the temperature was high. The August rate for the same time and area as in March was 8.25 milligrams.

7. A very striking adaptation to desert conditions is to be found in the promptness with which *Fouquieria* forms leaves when the water-supply of the plant is increased by the rains. As an example of this the following instances may be presented: For several weeks previous to the 11th of May one of the plants

studied had no leaves. Within 48 hours after the rain of May 11 it was well covered with them. On June 29, in the midst of a very dry period, three gallons of water were given to one specimen of *Fouquieria* and leaf-buds were observed on July 1, which by 2 P. M. on the succeeding day were 1 cm. long. On the fifth they were of mature size.

Fouquieria No. II formed five distinct leaf-coverings between February and August. The exciting cause in each instance was an increase in the water-supply. Very soon after the rains were over the leaves were dropped and excessive and destructive transpiration was thus avoided.

8. The daily periodicity of *Fouquieria* was observed in April. The rate varied in a manner corresponding to variations of the temperature, but not quite the same, and it inversely followed very closely the variation of the relative humidity.

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Studies on the effect of some concentrated solutions on the osmotic activity of plants*

Harriett Marie Martin

Turgidity, which is often of importance in bringing about rigidity in plant parts, is dependent to a great extent upon the osmotic pressure of the cell-sap, which keeps the cell-wall stretched to its greatest extent. The concentration of the cell-sap, upon which the osmotic pressure depends, varies according to the environment of the cell, and the permeability of the plasma-membranes.

Plasmolysis affords a means of studying the concentration of the cell-sap, and the changes which may be induced by the environment of the cell. If the cell lies in a solution more concentrated than the cell-sap, the greater osmotic pressure of the external solutes will cause a contraction of the protoplast. The protoplast will withdraw from the cell-wall to a greater or less extent, according to the increase or decrease of the difference between the external and internal osmotic pressures. It is this withdrawal of the protoplast from the cell-wall which constitutes plasmolysis.

In dealing with certain substances, glycerine, urea and acetamid, to which the plasma-membrane is more or less permeable, and which are considered harmless to the protoplast (Overton 17 and 18; Hampe 9; Beyer 2; de Vries 33; Klebs 10; Laurent 11; Meyer 14*b*), it was desired to ascertain if a stronger concentration of other substances would be necessary to bring about plasmolysis, after treatment with glycerine, urea, or acetamid, than under normal conditions.

Methods and experiments

In general, the experiments consisted in first determining the concentration of potassium nitrate, glycerine, urea, and acetamid isotonic with the cell-sap, namely such a solution as would just

*Contribution from the Botanical Department of Cornell University No. 104. Numbers 1–102 are listed in a History of Cornell University, published by The University Publishing Society of New York City, 1905.

produce plasmolysis. When these isotonic concentrations were determined, specimens were placed in the required concentration of glycerine, urea, or acetamid, and left until turgidity was restored. They were then tested with potassium nitrate to determine the concentration necessary to replasmolyze them. The exact method of experiment differed according to the material used, and may best be described under each material.

In order that more accurate results might be obtained, normal solutions of the substances used were made. The solutions were made up on the basis of taking the number of grams represented by the molecular weight of the solute, dissolved in a little distilled water, and this solution diluted to one litre. A normal solution is designated by *n*, a one half normal by *n*/2, etc.

Philotria

The presence of numerous chloroplasts, as well as the more or less rectangular appearance of the cells in optical section, show incipient plasmolysis readily. The plants used had been in jars of water in the greenhouse for about two months. Fresh sprigs from these were kept in a glass of water, which was frequently changed, on a table near a south window. The importance of having good fresh material cannot be overestimated.

In experimenting with *Philotria*, whole leaves were broken from the stem with a small pair of forceps. This usually injured some of the basal cells, which were therefore not considered in determining the necessary concentration for plasmolysis.

The surplus water was removed from the leaf before applying the plasmolyzing solutions, in order to preserve the concentration of the solution used. Care was taken, however, not to remove too much water, lest the leaf should become flaccid, and vitiate the results. The leaf was mounted in a drop or two of the plasmolyzing solution, under a cover-glass. This solution was drawn off once or twice by filter-paper, and fresh solution added, both to keep the concentration correct and to bring about more rapid diffusion.

Potassium nitrate. Isotonic concentration. — As a result of several general tests, it was found that *n*/4 potassium nitrate would just produce plasmolysis in leaves of *Philotria*. This concentration did not check cyclosis, and after two hours slow streaming was still visible.

Glycerine. (*a*) *Isotonic concentration.* — $n/3$ glycerine was the concentration required to produce plasmolysis in *Philotria.*

(*b*) *Increase in concentration of cell-sap.* — In order to determine the increase in the concentration (for potassium nitrate) due to the action of glycerine, a few leaves were placed in Van Tieghem cells filled with $n/3$ glycerine. After a lapse of some hours these were tested with solutions of potassium nitrate.

(1) $n/4$ potassium nitrate, the isotonic concentration, did not plasmolyze cells of *Philotria,* which had been in $n/3$ glycerine about five hours.

(2) It required $n/3$ potassium nitrate to plasmolyze cells which had been in $n/3$ glycerine five hours. The action was very uneven, showing complete plasmolysis in some cells and none in others, especially the apical cells. This was no doubt due to the greater permeability of the apical cells, which had therefore absorbed more glycerine.

(3) From $2n/5$ to $9n/20$ potassium nitrate was required to plasmolyze cells which had been in $n/3$ glycerine twenty-four hours.

The above experiments show that not only is the concentration of the cell-sap increased by the penetration of glycerine, but that the longer the action is allowed to go on the stronger the osmotic pressure of the cell-sap becomes.

Urea. (*a*) *Isotonic concentration.* — $n/4$ urea usually failed to plasmolyze cells of *Philotria,* but $n/3$ urea would plasmolyze nearly every cell.

(*b*) *Increase in concentration of cell-sap.* — Leaves were put in solutions in Van Tieghem cells, as in the above experiments with glycerine. Since $n/4$ urea sometimes produced plasmolysis, tests were made for increase in concentration of sap with both $n/4$ and $n/3$ urea.

(1) $n/3$ potassium nitrate produced only incipient plasmolysis in a few cells of leaves which had been in $n/4$ urea about twenty-four hours.

(2) $2n/5$ potassium nitrate was required to produce plasmolysis in such cells. The action was slow and gradual, varying from incipient to strong.

(3) $9n/20$ potassium nitrate was required to produce plasmolysis in leaves which had been in $n/3$ urea about seven hours.

Acetamid. — Since recovery from plasmolysis by acetamid usually occurs in a few minutes, the tests for increase in concentration of the sap were made upon the same cells soon after turgidity was restored.

(1) $n/3$ acetamid showed incipient plasmolysis. The cells were slowly replasmolyzed by $n/3$ potassium nitrate, incipiently at the apex, but stronger toward the base.

(3) $n/2$ acetamid plasmolyzed nearly all cells. It required from $n/3$ to $n/2$ potassium nitrate to replasmolyze such cells.

Tradescantia discolor

Free-hand sections were cut from the lower epidermis of *Tradescantia discolor*, whose cells have a red or violet-colored sap. These were mounted directly in the plasmolyzing solutions. The experiments showed a remarkable variation in the reaction of individual cells of a section, even in the same solution. In some merely incipient plasmolysis was produced, in others the action was quite strong. The cells over a vein were often more easily plasmolyzed than those between the veins.

Potassium nitrate. Isotonic concentration.—From $n/5$ to $n/6$ potassium nitrate was required to produce plasmolysis in *Tradescantia*. The action was more uniform with the $n/5$ solution.

Glycerine. (*a*) *Isotonic concentration.* — From $n/4$ to $n/5$ glycerine was necessary to produce plasmolysis. $n/5$ glycerine plasmolyzed most of the cells incipiently, whereas $n/4$ glycerine plasmolyzed all the cells clearly, some completely.

(*b*) *Increase in concentration of cell-sap.*

(1) In sections which had been in $n/5$ glycerine from six to eight hours, $n/5$ potassium nitrate showed no plasmolysis in most cells, though slight plasmolysis appeared in a few cells.

(2) $n/3$ potassium nitrate produced plasmolysis in such cells.

Urea. (*a*) *Isotonic concentration.* — $n/5$ to $n/6$ urea produced plasmolysis. The degree varied considerably with both solutions.

(*b*) *Increase in concentration of cell-sap.* — Sections of the lower epidermis of *Tradescantia* leaves were put in $n/5$ and in $n/6$ urea, and left seven or eight hours.

(1) $n/4$ potassium nitrate produced plasmolysis in the cells near a vein, but the action was very irregular.

(2) $n/3$ potassium nitrate produced plasmolysis in the cells as a whole.

(3) In sections which had been in $n/6$ urea about eight hours, $n/6$ potassium nitrate produced very slight plasmolysis in a few cells, but $n/5$ potassium nitrate plasmolyzed nearly all the cells, some quite strongly, thus showing that $n/6$ urea was not strong enough to increase the concentration of the sap.

Acetamid.

(1) $n/4$ acetamid was determined as the isotonic concentration. Sections which had been plasmolyzed by $n/4$ acetamid were replasmolyzed by $n/5$ potassium nitrate.

(2) $n/5$ acetamid plasmolyzed some cells, but the action was slow due to the weakness of the solution. $n/5$ potassium nitrate was required to plasmolyze such sections.

Beta vulgaris

Free-hand sections were cut from a red beet and mounted in a drop or two of the plasmolyzing solution, under a cover-glass. The cells near the epidermis were found best to work with, since they were of a deep-red color, and readily showed any change of position of the plasmatic membrane. But the paler parenchyma-cells were also considered.

Potassium nitrate. Isotonic concentration.

(1) $n/2$ potassium nitrate produced slight plasmolysis in some cells of red beet.

(2) $2n/3$ potassium nitrate produced plasmolysis in all cells; plasmolyzed strongly.

Glycerine. (*a*) *Isotonic concentration.* — $2n/3$ glycerine was found to be the isotonic concentration.

(*b*) *Increase in concentration of cell-sap.* — In carrying on experiments to determine the increase in concentration, sections of the beet were placed in small vials holding from 8 to 12 c.c. of solutions used. Turgidity was restored in five or six hours in sections of beet placed in $2n/3$ and also in $n/2$ glycerine.

(1) Cells which had been in $2n/3$ glycerine for six hours were replasmolyzed by $1.6n$ potassium nitrate. A few were replasmolyzed by $1.5n$ potassium nitrate.

(2) Those which had been in $n/2$ glycerine for six hours were replasmolyzed by $1.5n$ potassium nitrate; but the concentration increased later, so that $1.6n$ was required to produce plasmolysis.

The concentration did not exceed this in twenty-four hours.

Urea. (*a*) *Isotonic concentration.* — $3n/2$ urea just plasmolyzed the cells of red beet.

(*b*) *Increase in concentration of cell-sap.* — Sections which had been in $3n/2$ urea for seven hours, were replasmolyzed by $1.6n$ urea.

Acetamid. — $3n/2$ acetamid plasmolyzed these cells in about a minute. The action was a little stronger than with $3n/2$ urea.

Turgidity was usually restored in three to ten minutes.

(1) $3n/2$ potassium nitrate plasmolyzed these cells, slowly.

(2) $2n$ potassium nitrate produced too strong a plasmolysis.

(3) n potassium nitrate did not plasmolyze the cells at all.

Spirogyra

Fresh *Spirogyra* was obtained in April, and experiments carried on with this. A few threads were mounted on a slide, under cover-glass, in the plasmolyzing solution, which was drawn off two or three times by filter-paper, and fresh solutions applied. In testing for increase of concentration with glycerine, urea, and acetamid, some *Spirogyra* was put in the required solutions in small vials of about 15 c.c. capacity. In this way plenty of material could be used, and there was a better opportunity for obtaining uninjured threads.

Potassium nitrate. Isotonic concentration. — $n/5$ potassium nitrate usually produced slight plasmolysis, sometimes a stronger plasmolysis. In some cases, however, there was no plasmolysis produced by this concentration.

$n/4.5$ potassium nitrate produced plasmolysis in all cells. The degree varied from slight to rather strong, usually slight.

In these experiments, as in the others, there were usually one or two threads which were more difficult to plasmolyze than the others.

Glycerine. (*a*) *Isotonic concentration.*— *n*/4 glycerine produced incipient to slight plasmolysis in nearly all the cells. *n*/3 glycerine plasmolyzed all the cells.

In most of the cells the plasmolysis was slight, the protoplast withdrawing merely at the corners. In others it was stronger, so that the protoplast separated entirely from the end walls and formed ellipsoidal bodies.

(*b*) *Increase in concentration.*—It required 9*n*/20 potassium nitrate to replasmolyze cells which had been in *n*/4 glycerine from four to five hours. 9*n*/20 potassium nitrate plasmolyzed only some of the cells which had been in *n*/3 glycerine from four to five hours. *n*/2 potassium nitrate was required to replasmolyze all the cells. It required 2*n*/3 potassium nitrate to replasmolyze cells which had been in *n*/3 or *n*/4 glycerine for twenty-four hours.

Urea. (*a*) *Isotonic concentration.*—*n*/3 urea plasmolyzed the cells incipiently or slightly.

n/2 urea produced a stronger plasmolysis in all the cells.

(*b*) *Increase in concentration.*—*n*/2 potassium nitrate was required to produced plasmolysis in cells which had been in *n*/3 urea from four to six hours.

2*n*/3 potassium nitrate was necessary to replasmolyze cells which had been in *n*/2 urea for five hours.

Most of the threads were too greatly injured to test the concentration after twenty-four hours.

Acetamid. (*a*) *Isotonic concentration.*—2*n*/3 acetamid seemed to be the isotonic concentration. The plasmolysis varied from incipient to medium strong, and recovery was usually rapid

n/2 acetamid produced only very slight plasmolysis in some of the cells.

(*b*) *Increase in concentration.*—It required 2*n*/3 potassium nitrate to replasmolyze cells which had been in 2*n*/3 acetamid from five to ten minutes.

n/2 potassium nitrate produced plasmolysis in cells which had been in *n*/2 acetamid from five to ten minutes.

Acetamid is very injurious in its action on *Spirogyra.* Many threads showed signs of injury in less than two minutes. Only those which seemed healthy and uninjured were considered in the above experiments.

SUMMARY

The results of the above experiments may be summarized in the following tables:

TABLE I

ISOTONIC CONCENTRATION

Plant.	Potassium nitrate.		Glycerine.		Urea.		Acetamid.	
	Normal.	%	Normal.	%	Normal.	%	Normal.	%
Philotria (leaf).	$\frac{1}{4}$	2.52	$\frac{1}{3}$	3.07	$\frac{1}{3}$	2.0	$\frac{1}{2}$–$\frac{1}{3}$	2.95–1.97
Tradescantia discolor (lower epidermis).	$\frac{1}{5}$–$\frac{1}{6}$	2.02–1.68	$\frac{1}{4}$–$\frac{1}{5}$	1.84–1.53	$\frac{1}{5}$–$\frac{1}{6}$	1.2–1.0	$\frac{1}{4}$–$\frac{1}{5}$	1.48–1.18
Beta vulgaris (root).	$\frac{2}{3}$	6.73	$\frac{2}{3}$	6.13	$\frac{3}{2}$	9.0	$\frac{3}{2}$	8.85
Spirogyra.	$\frac{1}{4.5}$	2.25	$\frac{1}{3}$	3.07	$\frac{1}{3}$–$\frac{1}{2}$	2.0–3.0	$\frac{2}{3}$	3.94

TABLE II

INCREASE IN CONCENTRATION OF CELL-SAP

Plant.	Plasmolyzing agent.	Concentration of plasmolyzing agent.		Duration of action.	Isotonic concentration of KNO_3.		Increase of KNO_3.	Increase in concentration of cell-sap.
		N.	%		N.	%	%	
Philotria.	Glycerine.	$\frac{1}{3}$	3.07	5 hrs.	$\frac{1}{3}$	3.36	0.84	1.33
		$\frac{1}{3}$	3.07	24 "	$\frac{9}{20}$	4.55	2.03	1.80
	Urea.	$\frac{1}{3}$	2.0	7 "	$\frac{9}{20}$	4.55	2.03	1.80
		$\frac{1}{4}$	1.5	24 "	$\frac{2}{5}$	4.04	1.52	1.60
	Acetamid.	$\frac{1}{2}$	2.95	15 min.	$\frac{1}{3}$–$\frac{1}{2}$	3.36–5.05	0.84–2.53	1.33–2.0
		$\frac{1}{3}$	1.97		$\frac{1}{3}$	3.36	0.84	1.32
Tradescantia discolor.	Glycerine.	$\frac{1}{5}$	1.84	6 hrs.	$\frac{1}{3}$	3.36	1.34–1.68	1.66–2.0
	Urea.	$\frac{1}{5}$	1.2	7 "	$\frac{1}{5}$	2.02	0–0.34	1–1.2
		$\frac{1}{6}$	1.0	8 "	$\frac{1}{5}$	2.02	0–0.34	1–1.2
	Acetamid.	$\frac{1}{5}$	1.18	30 min.	$\frac{1}{5}$	2.02	0–0.34	1–1.2
		$\frac{1}{4}$	1.48	30 "	$\frac{1}{5}$	2.02	0–0.34	1–1.2
Beta vulgaris.	Glycerine.	$\frac{2}{3}$	6.13	6–24 hrs.	1.6	16.16	9.43	1.4
	Urea.	$\frac{3}{2}$	9.0	7 "	1.6	16.16	9.43	1.4
	Acetamid.	$\frac{3}{2}$	8.85	10–15 min.	$\frac{3}{2}$	15.15	9.42	1.6
Spirogyra.	Glycerine.	$\frac{1}{4}$	1.84	4–5 hrs.	$\frac{9}{20}$	4.55	2.30	2.02
		$\frac{1}{3}$	3.07	4–5 "	$\frac{1}{2}$	5.05	3.30	2.24
		$\frac{1}{4}$, $\frac{1}{3}$		24 "	$\frac{2}{3}$	6.73	4.48	2.99
	Urea.	$\frac{1}{3}$	2.0	4–6 "	$\frac{1}{2}$	5.05	2.80	2.24
		$\frac{1}{2}$	3.0	5 "	$\frac{2}{3}$	6.73	4.48	2.99
	Acetamid.	$\frac{2}{3}$	3.93	5–10 min.	$\frac{2}{3}$	6.73	4.48	2.99
		$\frac{1}{2}$	2.95		$\frac{1}{2}$	5.05	2.80	2.24

DISCUSSION

In carrying on plasmolytic experiments remarkable variability in the reaction of different cells, tissues, and plants may be observed. Yet there seem to be very definite influences at work which affect osmotic activity.

Variation in different plants. — It seems quite evident that plants may adapt themselves to environment in which it is difficult to obtain or to retain water, by increased concentration of the cell-sap. Pantanelli (19) quotes Cavaras to the effect that cold-enduring, salt and rock plants possess a very concentrated cell-sap. Ganong (8) remarks that there seems to be a close correspondence between halophilism of the plant and the power of its root-hairs to resist plasmolysis. The above experiments show that cells of the red beet have a much more concentrated cell-sap than *Tradescantia*.

Variation in different parts of plants. — De Vries (29) notes that the concentration necessary for plasmolysis differs for different parts or tissues of a plant, as well as for different plants. Apical cells have been generally considered to be much more difficult to plasmolyze than other cells, and the limit of concentration necessary to produce plasmolysis to decrease as the age of the cell increases (*cf.* Pfeffer 23, page 317; Ewart 6, page 12; de Vries 29). The above experiments with *Philotria* showed these variations clearly. The cells of the midrib were very difficult to plasmolyze, while those in adjoining parenchyma were usually among the first to show plasmolysis, as well as being plasmolyzed more strongly. But there seems to be some relation between the plasmolyzing substance in the substratum and the reaction of the apical and older cells, which would result from the varying permeability of the protoplast for different substances. In solutions of potassium nitrate and of urea, the cells near the midrib were plasmolyzed to a greater degree than the apical cells. The degree of plasmolysis, incipient in the apical cells gradually, increased in the older cells. With glycerine, however, the stronger plasmolysis occurred in the apical cells. But these cells, after turgidity had been restored, were the last to be replasmolyzed by potassium nitrate. Their greater permeability had allowed more of the glycerine to penetrate the protoplast, so that the concentration of the cell-sap was increased to a greater extent.

Permeability of plasma-membrane. — The permeability of the plasma membrane has been shown for many substances. Hampe (9), Beyer (2), de Vries (33), Klebs (10) and others have shown that urea and glycerine readily penetrate the protoplast without injury. Klebs (10, page 540) states that glycerine not only penetrates the protoplast, but is there metamorphosed, and as shown by Meyer (14*b*) and Laurent may be converted into starch by certain higher plants; but, he continues, that the presence of glycerine in the cell-sap does not increase the turgor, since water-extraction by potassium nitrate took place normally.

Other experiments do not seem to bear out this view. De Vries found that the osmotic pressure was increased by urea (33*b*) and glycerine (33*a*) so that a much stronger concentration of other plasmolyzing solutions was required to induce plasmolysis again. Famintzin's experiments (7) with the culture of algae showed that by a gradual increase in the concentration of the medium a very considerable number of salts could be transferred into the cell-sap, and the cells in this way accustomed to stronger solutions.

The experiments in the present investigation showed, in nearly every case, an increase in the concentration of the cell-sap under the influence of glycerine, urea, and acetamid. Of the plants used in the experiments, *Tradescantia* showed the least concentration in cell-sap, and the least increase in concentration. Yet in some cases glycerine doubled the concentration of the sap, and the action in general was much stronger than with urea or acetamid. Urea increased the concentration in *Tradescantia* much less than in the other plants studied.

Relation between increase of concentration of sap, and concentration of solution. — There is considerable difference in the action of these substances. Although the final concentrations often do not show great differences, if these concentrations are compared with the original concentrations of the plasmolyzing substances, the greater increase in osmotic pressure due to glycerine will be brought out. The results with red beet cells may be cited as an example. The plasmolyzing concentration of glycerine was $2n/3$, that of urea $3n/2$ which gives a difference of $5n/6$. Yet the same or a less concentration of potassium nitrate was required to re-plasmolyze cells treated with these solutions, showing that glycerine was able to produce a comparatively greater osmotic pressure than urea.

This difference is much more marked in the case of acetamid.

The concentrations necessary to plasmolyze *Spirogyra* cells were $n/3$ glycerine, and $n/2$ acetamid. But the glycerine produced as great an osmotic pressure as the acetamid.

The action of acetamid in general seems to differ markedly from that of glycerine and urea. The latter substances produce a final concentration in the cell considerably higher than that of the plasmolyzing solution. For example, in the experiments just quoted the $n/3$ glycerine required an $n/2$ potassium nitrate to produce replasmolysis. But acetamid produces a final osmotic pressure equal to that of the solution used to plasmolyze the cells. An $n/2$ acetamid required an $n/2$ potassium nitrate to produce replasmolysis.

The above variations in the increase of concentration tend to show that the time necessary for the recovery of turgidity needs to be considered. After treatment with glycerine or urea, which require several hours for the plant to recover turgidity, a stronger concentration of potassium nitrate is required for replasmolysis, than after treatment with acetamid, in which the plant quickly regains turgidity. This was shown not only in *Philotria* but to a less extent in *Tradescantia*. — In *Philotria* it requires from $9n/20$ to $2n/5$ potassium nitrate to replasmolyze cells which have been plasmolyzed with $n/3$ solutions of glycerine or urea, whereas $n/3$ potassium nitrate produced plasmolysis in cells treated with $n/3$ acetamid. During the hours in which turgidity is being restored in cells plasmolyzed by glycerine or urea, osmotically active products may be formed in the cells. The short time required for turgidity to be restored in acetamid, as well as the fact that turgor is not raised above the osmotic pressure of the plasmolyzing solution, would seem to show that the increased turgor, in this case, was due merely to the penetration of the surrounding solution.

The strength of the solution used also has an influence on the increase of sap-concentration. A more concentrated solution will produce a greater increase in turgor than a weaker solution. The concentration of the sap in *Philotria* was increased 1.8 times in $n/3$ urea, but only 1.6 times in $n/4$ urea; or, expressed in terms of the increase in per cent. of potassium nitrate, 2.03 per cent. in $n/3$ urea, 1.52 per cent. in $n/4$ urea. Acetamid showed a marked difference in *Philotria*. In $n/2$ acetamid the concentration was doubled, whereas in $n/3$ acetamid the concentration was only 1.33 times the normal sap. That, in general, there is an optimum concentration of the solution which will produce a maximum increase in turgor, and a maximum concentration of the solution beyond which no further increase in turgor will take place, and which may cause the death of the plant, has been shown by the experiments of Stange (26).

CONCLUSIONS

The concentration of cell-sap varies in different plants. It is comparatively weak in *Tradescantia discolor*, but much more concentrated in *Beta vulgaris*.

The limit of concentration necessary to produce plasmolysis varies in different parts and tissues of the plant according to the age of the cell, to the permeability of the protoplast, and to the plasmolyzing substance. With potassium nitrate and urea, the apical cells of *Philotria* were plasmolyzed incipiently, and the degree of plasmolysis gradually increased in the older cells. Glycerine, however, produced strongest plasmolysis in the apical cells. In all cases a stronger concentration of glycerine than of potassium nitrate was required to produce plasmolysis. Acetamid required the strongest concentration of the solutions used. The concentration of urea varied, but was sometimes stronger than that of glycerine.

The concentration of the cell-sap may be increased by the penetration of glycerine, urea, or acetamid. A comparison of the increase in concentration due to the various substances shows that glycerine produces relatively, and sometimes actually, the greatest increase. For, although, in some cases, as in *Philotria* and *Spirogyra*, urea and acetamid may produce a greater actual increase, this was due to the greater concentration of the plasmolyzing solutions. Acetamid cannot increase the concentration of the sap above the concentration of the plasmolyzing solution.

The duration of the action of the plasmolyzing solution influences the increase in the concentration of the sap. Glycerine and urea, whose action continues several hours, produce a relatively greater increase in the concentration than acetamid, whose action is very quick. The increase in the concentration of the sap of *Spirogyra* in solutions of glycerine was greater after twenty-four hours than after five hours.

The concentration of the plasmolyzing solution influences the increase in the concentration of sap. $n/2$ urea increased the concentration of sap in *Spirogyra* 2.99 times, whereas $n/3$ urea increased it 2.24 times. The greater increase takes place in the stronger concentration of the plasmolyzing solution.

This paper was submitted by Professor Atkinson to Professor Wilder D. Bancroft of the Chemical Department, who very kindly read it for the purpose of passing on the question of chemistry involved. He has suggested that the increase in concentration is due to the fact that the solutions, glycerine, urea, and acetamid pass through the plasma-membrane into the cell-sap, until the concentration of the solutes used is equal on both sides of the membrane, without reference to the concentration of other substances in the sap. Thus the total concentration in the sap may be equal to the original concentration of the sap plus the concentration of the glycerine, urea, or acetamid solutions used. Turgor would be restored when enough of the solution had penetrated so that the total concentration within the cell equaled the concentration in the external medium. If the plant remained in the solution after the turgor was restored, osmotic action might continue until the concentration of the solutes used would be equal on both sides of the membrane, and the total concentration would be greater than that of the external solution.

This hypothesis would explain the cases where the increase in concentration was equal to or less than the concentration of the plasmolyzing solution, as in the experiments with *Tradescantia* and *Philotria*, and all the experiments with acetamid. The increase in concentration above that of the external solution, amounting in *Beta* to 6.88 per cent., and in *Spirogyra* from 1.33–1.48 per cent. in glycerine solution, seems remarkable. In this connection reference may be made to the conclusion of Loeb (Studies in General Physiology, page 553) that "the simple osmotic theory of absorption which has been accepted by botanists cannot possibly be correct." This conclusion was based upon experiments with muscles, and *Fundulus*. "The fact that *Fundulus* can be thrown from sea-water into distilled water without any considerable swelling, or without any visible injurious effects, may find its explanation through the influence that various ions have upon the absorption of liquids."

Further investigations are needed to determine the causes for such an increase in concentration. Whether the substances undergo changes within the cell, and to what extent the changes take place, might be revealed in experiments upon growth of plants in the different solutions.

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BIBLIOGRAPHY

1. **Beauverie, J.** Influence de la pression osmotique du milieu sur la forme et la structure des végétaux. Acad. Sci. Paris Compt. Rend. **132**: 226–229. 1901.
2. **Beyer, A.** Landwirtsch. Versuchsstat. **11**: —. 1869.
3. **Bower, F. O.** On plasmolysis and its bearings upon the relations between cell-wall and protoplasm. Quart. Jour. Microsc. Sci. **23**: 151-167. 1885.
4. **Copeland, E. B.** Relation of nutrient salts to turgor. Bot. Gaz. **24**: 399–416. 1897.
5. **Dandeno, J. B.** An investigation into the effects of water and aqueous solutions of some of the common inorganic substances on foliage leaves. Trans. Canad. Inst. **7**: 237–250. Exp. Sta. Rec. **16**: 19. 1904.
6. **Ewart, A. J.** Protoplasmic streaming in plants. 1902.
7. **Famintzin, A.** Die anorganischen Salze als ausgezeichnetes Hülfsmittel zum Studium der Entwickelung niederer chlorophyllhaltiger Organismen. Melanges Biol. **8**: 226. 1871.
8. **Ganong, W. F.** The vegetation of the Bay of Fundy salt and diked marshes: an ecological study. Bot. Gaz. **36**: 161. 1903.
9. **Hampe, W.** Landwirtsch. Versuchsstat. **9**: —. 1867.
10. **Klebs, G.** Beiträge zur Physiologie der Pflanzenzelle. Unters. Bot. Inst. Tübingen **2**: 489. 1888; Ber. Deuts. Bot. Gesells. **5**: 181–189. 1887.
11. **Laurent, J.** Sur l'absorption des matières organiques par les racines. Acad. Sci. Paris Compt. Rend. **125**: 887–889. 1897.
12. **Livingston, B. E.** The rôle of diffusion and osmotic pressure in plants. Dec. Pub. Univ. Chicago II. **8**: i—xiii, 1–149. 1903.
13. **Massart, J.** Sensibilité et adaption des organismes à la concentration des solutions salines. Arch. de Biol. **9**: 515–570. 1899.
14. **Mayer, A.** (*a*) Lehrbuch der Agriculturchemie. (*b*) Bildung der Stärkekörner in den Laubblättern aus Zuckerarten, Mannit und Glycerin. Bot. Zeit. **44**: 81. 1886.
15. **Molisch, H.** Ueber den mikrochemischen Nachweis von Nitraten und Nitriten in der Pflanze mittelst Diphenylamin oder Brucin. Ber. Deuts. Bot. Gesells. **1**: 150–155. 1883. Sitzungsber. Akad. Wiss. Wien, I Abth., 221. 1887.
16. **Ono, N.** Ueber die Wachstumsbeschleunigung einiger Algen und Pilze durch chemische Reize. Jour. Coll. Sci. Imp. Univ. Tokyo **13**: 141. 1900. Bot. Mag. Tokyo **14**: 75. 1900. Rev. in Bot. Gaz. **30**: 422. 1900.

17. **Overton, E.** Ueber die osmotischen Eigenschaften der lebenden Pflanzen- und Tierzelle. Vierteljahrssch. Naturf. Ges. Zurich **40** : 159–184. 1895.
18. ——. Ueber die allgemeinen osmotischen Eigenschaften der Zelle, ihre vermutlichen Ursachen und ihre Bedeutung für die Physiologie. Vierteljahrsschr. Naturf. Ges. Zurich **44** : 88–135. 1899.
19. **Pantanelli, E.** Zur Kenntniss der Turgorregulationen bei Schimmelpilzen. Jahrb. Wiss. Bot. **40** : 303. 1904.
20. **Pfeffer, W.** Osmotische Untersuchungen. 1877.
21. ——. Ueber Aufnahme von Anilinfarben in lebende Zelle. Unters. Bot. Inst. Tübingen **2** : 179–332. 1886.
22. ——. Zur Kenntniss der Plasmahaut und der Vacuolen. Abhandl. K. Sächs. Ges. Wiss. Math.-Phys. Klasse **16** : 187–344. 1890.
23. ——. Druck- und Arbeitsleistung durch wachsende Pflanzen. Abhandl. K. Sächs. Ges. Wiss. Math.-Phys. Klasse **20** : 233–474. 1893.
24. ——. Physiology of Plants, Engl. ed. 1903.
25. **Sawa, S.** Has urea any poisonous action on phaenogams? Bull. Col. Agr. Imp. Univ. Tokyo **4** : 413, 414. 1902.
26. **Stange, B.** Beziehungen zwischen Substratconcentration, Turgor, und Wachsthum bei einigen phanerogamen Pflanzen. Bot. Zeit. **50** : 253. 1892.
27. **True, R. H.** The physiological action of certain plasmolyzing agents. Bot. Gaz. **26** : 407–416. 1898.
28. **Van Rysseberghe, F.** Reaction osmotique des cellules végétales à la concentration du milieu. Mém. Cour. Acad. Roy. Belg. **58** : 1–101. 1898.
29. **Vries, H. de.** Untersuchungen ueber die mechanischen Ursachen der Zellstreckung. Leipzig, 1877.
30. ——. Zur plasmolytischen Methodik. Bot. Zeit. **42** : 289–298. 1884.
31. ——. Eine Methode zur Analyse der Turgorkraft. Jahrb. Wiss. Bot. **14** : 427–601. 1884.
32. ——. Plasmolytische Studien über die Wand der Vacuolen. Jahrb. Wiss. Bot. **16** : 465–593. 1885.
33. ——. (*a*) Ueber den isotonischen Coëfficient des Glycerins. Bot. Zeit. **46** : 229. 1888. (*b*) Uber die Permeabilität der Protoplaste für Harnstoff. Bot. Zeit. **47** : 309. 1889.
34. ——. Sur la permeabilité du protoplasma des betteraves rouges. Archives Néerlandaises **6** : —. 1871.
35. **Wieler, A.** Plasmolytische Versuche mit unverletzten phanerogamen Pflanzen. Ber. Deuts. Bot. Gesells. **5** : 375–380. 1887.
36. **Wortmann, J.** Ueber den Nachweis, das Vorkommen und die Bedeutung des diastatischen Enzyms in den Pflanzen. Bot. Zeit. **48** : 581. 1890.

Chroolepus aureus a lichen

Albert Schneider

(With plate 22)

During my study of the lichen formations in the vicinity of the Minnesota Seaside Station (near Port Renfrew, Vancouver Island, B. C.), I frequently found *Chroolepus aureus* (L.) Kütz. [*Trentepohlia aurea* (L.) Mart.] on trees (spruce and hemlock) and on rocky ledges overhanging the beach. It is exceedingly abundant in certain circumscribed areas and shows great variability in the length of filaments. There was also observable a marked difference in color, varying largely between that of old gold and a bright orange-brown. As to whether the difference in color indicated two distinct species I will not venture an opinion at present, although the indications are that that is the case. It is very essential that these plants should be studied in the fresh state as they lose the characteristic color very quickly when placed in the herbarium, which increases the difficulties in the way of identification.

The representatives of the genus *Chroolepus* are especially interesting because of their tendency to associate themselves biologically with fungi to form lichens. *Chroolepus umbrinus* (represented in thirteen lichen genera), or a species closely similar to it, forms the algal symbiont of many lichen species. Bearing this in mind, a more careful study was made of *C. aureus*, to determine if this plant presented this character to any marked degree. Fresh material, obtained from ledges of overhanging sandstone and from trunks and branches of hemlocks, was carefully examined under the microscope. The normal filaments showed a variation in length as shown in plate 22. The cells contain numerous reddish-brown granules or globules. Very frequently there was found a twining hyphal fungus, especially abundant about the bases of the filaments. This fungus was, however, not sufficiently constant in its appearance to warrant the assumption that it represented a marked biological association with the alga, either antagonistic or mutualistic. More likely it represents merely an accidental association, due to the fact that both organisms live upon the same substratum and require the same or similar moisture and light conditions.

The interesting feature, however, was a delicately reticulate, spirally wound, network of what appeared to be the hyphal tissue of a fungus which entirely enwrapped the algal threads from base to apex and projected a short distance beyond the apex of most threads. In some instances, this structure extended only to the apex or within a short distance of the tip. This network is very firmly attached to the algal cell-wall. Only after the application of strongly alkaline or strongly acid solutions was it possible to induce it to separate from the algal cells, assisted by pressing the material quite forcibly under the cover-glass. Even then, only fragments could be removed which showed the reticulation very clearly (see plate). The network gives to the filaments a roughened appearance, with here and there a delicate thread (simple or sparingly branched) of the network projecting out from the algal filament. As stated, this mesh-work extends a short distance beyond the apex of the algal thread, in the form of a tube, partially divided across by the same network, thus giving the semblance of partial septation. One, two, or three of these compartments were noticeable, never more. It appears that the compartments are occupied by the new algal cells as the filament grows in length; however, new mesh compartments are always formed in advance of the algal cells.

It would appear that this finely reticulate, colorless network is the hyphal tissue of a fungus which invests the algal filaments, indicating a very intimate biological relationship. It represents a condition not unlike that which exists in the well-known lichen *Ephebe pubescens* Fr., only the fungal symbiont does not penetrate the algal tissue. The hyphal structure of the fungal symbiont in both is closely similar excepting that the anastomoses are much more common in *Chroolepus aureus*. No experiments have been made to determine the biological relationship of the two symbionts, whether antagonistic or mutualistic. Nor was it possible, at the time, to determine conclusively whether or not the fungal symbiont is always present. It was present in all of the material examined, although specimens were found in which the reticulation was rather indistinct. Some authors speak of this terminal structure as a "cellulose cap," without explaining its nature and use.

There seems to be little doubt that the network described represents a fungus symbiotically associated with the alga *Chroolepus aureus*. This association appears to be sufficiently constant to warrant placing this structure, heretofore classed as an alga, with the class *Lichenes*. The fungal symbiont does not appear to develop spores or any of the other special structures found with the fungal symbionts of the majority of lichens.

UNIVERSITY OF CALIFORNIA, DEPARTMENT OF PHARMACY.

Explanation of plate 22

A, Filaments of *Chroolepus aureus*, showing the enclosing fungal meshwork (a, b) and special algal filaments (c).

B, Long filaments of *Chroolepus* with the enclosing meshwork removed.

C, Terminal portion of algal filament, more highly magnified. The extreme tip is always free of the fungal symbiont.

D, Basal portion of algal filament, showing the delicate meshwork (b) and the twining filaments of a coarser hyphal fungus (a).

E, A portion of the fungal meshwork removed from the algal filament, showing the characteristic reticulation.

Magnification of *A* and *B* about 225 diameters, of *C*, *D* and *E* about 300 diameters.

Poa gracillima Vasey and its allies

CHARLES VANCOUVER PIPER

The *Poa* species of the group related to *P. gracillima* Vasey are separable with difficulty, and distinguished only by slight characters. They are characterized among the western poas by their tufted habit, narrow flaccid leaves, loose open panicles, and by their growing on cliffs. The 7 species may be distinguished by the following key:

Ligules of the sterile shoots obsolete or nearly so, those of the culm-leaves short and truncate. *P. Multnomae.*

Ligules of all the leaves moderately developed, 1–2 mm. long.

- Low plants, 5–10 cm. high; panicle small, usually purple, of few spikelets, the rays divaricate. *P. vaseyochloa.*
- Taller, 10–30 cm. high; panicle with many spikelets, the rays not divaricate.
  - Panicle rather close; spikelets 6–9 mm. long; glumes of firm texture; blades flat. *P. saxatilis.*
  - Panicle loose; spikelets 7 mm. long; glumes thin; blades involute. *P. gracillima.*

Ligules of all the leaves rather long, 2–5 mm. long.

- Panicle rather stiff, the rays short; blades flat.
  - Rays in about eight series of 3–5 each; flowering glumes pubescent toward the base. *P. invaginata.*
  - Rays in about five series of 1 or 2 each; flowering glumes minutely scabrous to the tip, puberulent at base. *P. acutiglumis.*
- Panicle loose, the rays somewhat drooping, in about five series of 2 or 3 each; flowering glumes puberulent at base. *P. alcea.*

It is very doubtful if all these species can be maintained. Only careful field work and good series of specimens will enable the problem to be solved. *Poa vaseyochloa* is probably only a starved form of *P. gracillima,* from which *P. saxatilis* also is scarcely distinguishable. The ligule character may prove illusory, but large series of *Poa alcea* and *P. Multnomae* indicate otherwise.

Poa Multnomae sp. nov.

Sporobolus Bolanderi Vasey, Bot. Gaz. **11**: 337. 1886. Not *Poa Bolanderi* Vasey, Bot. Gaz. **7**: 32. 1882.

Perennial, densely tufted, with numerous slender innovations: culms slender, 2- or 3-jointed, often geniculate at base, terete, smooth, and shining, 10–30 cm. high: sheaths glabrous, faintly striate, often purplish, shorter than the internodes; blades narrow, soft, smooth, folded or sometimes flat, 8–12 cm. long; ligules scarious, those of the culm 1–2 mm. long, of the innovations nearly obsolete: panicle loose, often one-sided, 5–10 cm. long, usually pale-green, sometime purplish, the slender, nearly smooth rays in about five series of 2 or 3 each: spikelets broadly lanceolate, 5–7 mm. long, 3–5-flowered: empty glumes lanceolate, smooth, scarious-margined, 3-nerved, the lower about 3 mm., the upper 4 mm. long; flowering glume ovate, acutish, sparsely crisp-puberulent at base, the lateral nerves disappearing in the scarious apex; palet as long as the flowering glume, notched at apex, the nerves ciliate-scabrous.

Type specimens collected at Multnomah Falls, Oregon, June 25, 1904, *Piper 6459*. This is the common *Poa* on the cliffs along the Columbia River, heretofore confused with *P. gracillima* Vasey.

The type of *Sporobolus Bolanderi* Vasey is also from Multnomah Falls, and is an overmature specimen from which most of the spikelets have fallen, which led to its being mistaken for a *Sporobolus*. On account of its poor condition, I indicate a new type for the species.

Poa alcea sp. nov.

Perennial, tufted, with numerous innovations: culms slender, terete, erect, smooth, 2- or 3-jointed, 30–50 cm. high: sheaths smooth, shorter than the internodes, often purplish; blades soft and smooth, narrowly linear, folded or loosely involute, 8–15 cm. long; ligules scarious, ovate, decurrent, those of the culm-leaves 2–4 mm. long, of the basal leaves shorter: panicle lax, pyramidal, often somewhat drooping, 5–12 cm. long; rays in about 5 series, mostly in twos and threes, and unequal, sparsely scabrous: spikelets oblong, 6–9 mm. long, mostly 5-flowered, pale-green or somewhat purple-tinged: empty glumes smooth, scarious-margined, oblong-lanceolate, acutish, the lower 1-nerved or sometimes 3-nerved, 3 mm. long, the upper longer, somewhat broader, 3-nerved; flowering glume thin-membranous, elliptic-ovate, obtuse, 3.5–4 mm. long, silvery-puberulent near the base, the lateral nerves vanishing in the scarious apex; palet oblong, notched at apex, as long as the flowering glume, the nerves ciliate-scabrous, the lateral portion half as broad as the internerve.

Abundant on Elk Rock near Portland, Oregon, where it was collected June 3, 1904, *Piper, 6463*. The following specimens also are referred here, all of Oregon:

Trask River, *Howell 761* in 1880; without locality, *Howell 73*, July 11, 1882, and *Henderson 9*, in 1883.

This is certainly exceedingly close to *Poa Multnomae* described above, but the ligule character, which seems very constant in the difficult western poas, together with the larger size, is relied upon to distinguish it.

From *Poa acutiglumis* Scribn. it may be distinguished by its more lax, larger panicles, larger leaves, smaller spikelets, and different flowering glumes.

BUREAU OF PLANT INDUSTRY,
UNITED STATES DEPARTMENT OF AGRICULTURE.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Allen, C. E. Nuclear division in the pollen mother-cells of *Lilium canadense.* Ann. Bot. **19**: 189–258. *pl. 6–9.* Ap 1905.

Ames, O. *Orchidaceae:* illustrations and studies of the family *Orchidaceae,* issuing from the Ames Botanical Laboratory, North Easton, Massachusetts. Fascicle I.. i–vii. 1–156. *pl. 1–16.* 8 Ap 1905.
Including descriptions of several new species from the Philippine Islands.

Arnell, H. W. Phaenological observations on mosses. Bryologist **8**: 41–44. 1 My 1905.

Arthur, J. C. Cultures of *Uredineae* in 1904. Jour. Myc. **11**: 50–67. 29 My 1905.

Arthur, J. C. Leguminous rusts from Mexico. Bot. Gaz. **39**: 385–396. 22 Je 1905.
With new species in *Uromyces* (4), *Calliospora* gen. nov. (3), *Uredo,* and *Ravenelia* (5).

Arthur, J. C. On the nomenclature of fungi having many fruit-forms. Plant World **8**: 71–76. [Ap] 1905; 99–103. [My] 1905.

Bailey, W. W. About milkweeds. Am. Bot. **8**: 103–106. [Jl] 1905.

Bailey, W. W. Air plants. Am. Bot. **9**: 7–9. Jl 1905.

Bailey, W. W. Early wild flowers. Plant World **8**: 104, 105. [My] 1905.

Bailey, W. W. Pea-flowers in summer. Am. Bot. **8**: 81–83. [Je] 1905.

Bailey, W. W. Various loosestrifes. Am. Bot. **8**: 67–69. [My] 1905.

Baker, C. F. Notes on the fauna and flora of Catalina Island. Bull. So. Calif. Acad. Sci. **4**: 56–59. 18 My 1905.

Chiefly zoölogical; a few fungi are mentioned.

Bartlett, H. H. *Polygonum exsertum* in Massachusetts. Rhodora **7**: 140. 8 Jl 1905.

Bates, J. M. Rust notes for 1904. Jour. Myc. **11**: 116, 117. 19 Jl 1905.

Beal, W. J. The gas plant. Plant World **8**: 121–123. *f. 27, 28.* [Je] 1905.

Beardslee, H. C. The rosy-spored agarics or *Rhodosporae.* Jour. Myc. **11**: 109, 110. *pl. 76, 77.* 19 Jl 1905.

Bergen, J. Y. Federico Delpino. Science II. **21**: 996. 30 Je 1905.

Berry, E. W. A *Ficus* confused with *Proteoides.* Bull. Torrey Club **32**: 327–330. *pl. 21.* 30 Je 1905.

Berry, E. W. Fossil grasses and sedges. Am. Nat. **39**: 345–348. *f. 1.* 13 Je 1905.

With a description of *Carex Clarkii* sp. nov.

Berry, E. W. Three cotyledons in *Juglans.* Torreya **5**: 87. 25 My 1905.

Best, G. N. A lesson in systematic bryology. Bryologist **8**: 17–22. *pl. 2.* 7 Mr 1905.

Blankinship, J. W. Supplement to the flora of Montana: additions and corrections. Montana Agric. Coll. Sci. Stud. Bot. **1**: 33–109. *pl. 1–6.* 25 Ap 1905.

Includes descriptions of 28 new species and varieties, in 21 genera.

Blankinship, J. W. & Henshall, H. F. Common names of Montana plants. Montana Agric. Coll. Sci. Stud. Bot. **1**: 113–139. 6 My 1905.

Britton, E. G. Bryological notes—II. Bull. Torrey Club **32**: 261–268. 27 My 1905.

Two new genera, *Pseudocryphaea* and *Dendroalsia*, and 2 new species in *Erpodium.*

Britton, E. G. Notes on nomenclature. V. Bryologist **8**: 49. 1 My 1905.

Britton, N. L. Explorations in the Bahamas. Jour. N. Y. Bot. Gard. **6**: 78–85. *f. 17–21.* My 1905.

Crockett, A. L. *Rhacomitrium heterostichum gracilescens.* Bryologist **8**: 33. 7 Mr 1905.

Notes its occurence in Maine.

Cushman, J. A. A contribution to the desmid flora of New Hampshire. Rhodora **7**: 111–119. *pl. 61.* 1 Je 1905.

New species are described in *Closterium* and *Pleurotaenium.*

Cushman, J. A. A few Ohio desmids. Ohio Nat. **5**: 349, 350. 15 My 1905.

Darbishire, O. V. An apparatus for observing the transpiration stream. Bot. Gaz. **39**: 356–364. *f. 1, 2.* 20 My 1905.

Davenport, G. E. A new type of *Aneimia.* Fern Bull. **13**: 18–21. [Ap] 1905. [Illust.]

A. Brandegeea sp. nov., from Mexico.

Dean, A. L. On proteolytic enzymes. Bot. Gaz. **39**: 321–339. 20 My 1905.

Duggar, B. M. Plant physiology — present problems. Science II. **21**: 937–953. 23 Je 1905.

Eaton, A. A. Notes on *Isoetes.* Fern Bull. **13**: 51–53. [My] 1905.

With descriptions of a new species and 2 new varieties.

Eggleston, W. W. *Amelanchier arguta* Nutt. Torreya **5**: 107, 108. 24 Je 1905.

Eggleston, W. W. The fern flora of Vermont. Fern Bull. **13**: 33–41. [My] 1905.

Ellis, J. B. A new *Rosellinia* from Nicaragua. Torreya **5**: 87. 25 My 1905.

R. Bakeri sp. nov.

Ellis, J. B. & Bartholomew, E. Two new haplosporellas. Jour. Myc. **11**: 108. 19 Jl 1905.

Descriptions of 2 new species of *Haplosporella* from Kansas.

Ellis, J. B. & Everhart, B. M. New fungi from Catalina Island. Bull. So. Calif. Acad. Sci. **4**: 62, 63. 18 My 1905.

Descriptions of 3 new species in as many genera.

Evans, A. W. *Hepaticae* of Puerto Rico — V. *Ceratolejeunea.* Bull. Torrey Club **32**: 273–290. *pl. 19, 20.* 30 Je 1905.

One species is described as new.

Fernald, M. L. The North American species of *Eriophorum.* Part 1. Synopsis of American species. Rhodora **7**: 81–92. 12 My 1905; Part 2. Notes on the preceding synopsis. Rhodora **7**: 129–136. 8 Jl 1905.

Fernald, M. L. & Knowlton, C. H. *Draba incana* and its allies in northeastern America. Rhodora **7**: 61–67. *pl. 60.* 14 Ap 1905.

Includes descriptions of two new species.

Fink, B. Further notes on cladonias. V. *Cladonia gracilis.* Bryologist **8**: 37–41. *pl. 4.* 1 My 1905.

Fink, B. How to collect and study lichens. Bryologist **8**: 22–27. 7 Mr 1905.

Fischer, W. A list of Ohio plants with compound leaves. Ohio Nat. **5**: 340–343. 15 My 1905.

Flett, J. B. Observations on *Lycopodium lucidulum.* Fern Bull. **13**: 48. [My] 1905.

Frye, T. C. & Blodgett, E. B. A contribution to the life history of *Apocynum androsaemifolium.* Bot. Gaz. **40**: 49–53. *pl. 2.* 18 Jl 1905.

Gager, C. S. The "monsoon-dust" of the South Atlantic Ocean. Plant World **8**: 124, 125. *f. 29.* [Je] 1905.

Gilg, E. A new gentian from Bolivia. Torreya **5**: 109. 24 Je 1905.
Gentiana dolichantha sp. nov.

Gilman, C. Two ferns new to the flora of Vermont. Rhodora **7**: 103–105. 1 Je 1905.

Greene, E. L. Derivation of the name *Chamaecrista.* Torreya **5**: 126–128. 27 Jl 1905.

Greene, E. L. The earliest local flora. Plant World **8**: 115–121. *f. 26.* [Je] 1905.

Greene, E. L. Some *Ptelea* segregates. Torreya **5**: 99, 100. 24 Je 1905.
Descriptions of 3 new species.

Greenman, J. M. Descriptions of spermatophytes from the southwestern United States, Mexico, and Central America. Proc. Am. Acad. Arts & Sci. **41**: 235–270. 24 Jl 1905.
Includes descriptions of 2 new genera and 49 new species.

Grout, A. J. Notes on Vermont bryophytes. Bryologist **8**: 51–53. 1 My 1905.

Gruber, C. L. *Crataegus* in Berks County, Pennsylvania — III. Bull. Torrey Club **32**: 389–392. 29 Jl 1905.
With descriptions of 5 new species and varieties.

Haberer, J. V. Plants of Oneida County, New York, and vicinity, — I. Rhodora **7**: 92–97. 12 My 1905; 106–110. 1 Je 1905.

Harper, R. M. Coastal plain plants in New England. Rhodora **7**: 69–80. 14 Ap 1905.

Harper, R. M. The fern flora of Georgia. Fern Bull. **13**: 1–17. [Ap] 1905.

Harper, R. M. Two misinterpreted species of *Xyris*. Torreya **5**: 128–130. 27 Jl 1905.

Harshberger, J. W. Suggestions toward a phytogeographic nomenclature. Science II. **21**: 789, 790. 19 My 1905.

Haynes, C. C. Notes on a colony of hepatics found associated on a dead fungus. Bryologist **8**: 29–31. *pl. 3.* 7 Mr 1905.

Hemsley, W. B. *Cacalia tuberosa.* Curt. Bot. Mag. IV. **1**: *pl. 8022.* 1 Jl 1905.

Native of North America.

Hemsley, W. B. *Pernettya mucronata* (varietates diversae). Curt. Bot. Mag. IV. **1**: *pl. 8023.* 1 Jl 1905.

Native of southern Chile and Patagonia.

Hervey, E. W. *Silene conica* in New England. Rhodora **7**: 110. 1 Je 1905.

Hill, E. J. *Equisetum scirpoides* in Illinois. Fern Bull. **13**: 21–23. [Ap] 1905.

Hitchcock, A. S. Nomenclatorial type specimens of plant species. Science II. **21**: 828–832. 26 My 1905.

Hollick, A. The preservation of plants by geologic processes. Jour. N. Y. Bot. Gard. **6**: 115–118. *f. 28–30.* Jl 1905.

Holway, E. W. D. North American *Uredineae.* **1**: 1–32. i–iii. *pl. 1–10.* 15 Ap 1905.

Holzinger, J. M. Some recently described North American *Polytricha.* Bryologist **8**: 29–31. *pl. 3.* 7 Mr 1905.

House, H. D. Further notes on the orchids of central New York. Bull. Torrey Club **32**: 373–382. 29 Jl 1905.

House, H. D. Notes on New Jersey violets. Bull. Torrey Club **32**: 253–260. *pl. 16–18.* 27 My 1905.

Description of a new species and a new hybrid, and a key to all species of *Viola* known from New Jersey.

Howe, M. A. Phycological studies — I. New *Chlorophyceae* from Florida and the Bahamas. Bull. Torrey Club **32**: 241–252. *pl. 11–15.* 27 My 1905.

New species in *Halimeda*, *Siphonocladus*, and *Petrosiphon* gen. nov.

Jackson, D. J. Movements of diatoms and other microscopic plants. Am. Nat. **39**: 287–291. 6 My 1905.

Johnson, D. S. Seed development in the *Piperales* and its bearing on the relationship of the order. Johns Hopkins Univ. Circ. **1905**[5]: 28–31. My 1905.

Johnston, J. R. New plants from the islands of Margarita and Coche, Venezuela. Proc. Am. Acad. Arts & Sci. **40**: 681–698. 21 Ap 1905.

Descriptions of 35 new species in 30 genera, of which one is new: *Anguriopsis.*

Jones, W. W. A revision of the genus *Zexmenia.* Proc. Am. Acad. Arts & Sci. **41**: 141–167. 23 Je 1905.

Six species are described as new.

Kauffman, C. H. The genus *Cortinarius*: a preliminary study. Bull. Torrey Club **32**: 301–325. *f. 1–7.* 30 Je 1905.

With a partial key and descriptions of 7 new species.

Kneucker, A. Bemerkungen zu den "*Carices* exsiccatae" XIIa Lieferung 1904. Allgem. Bot. Zeits. **11**: 9–12. 15 Ja 1905; 32–35. 15 F 1905.

Kneucker, A. Bemerkungen zu den "*Gramineae* exsiccatae" XVII und XVIII Liefurung 1905. Allgem. Bot. Zeits. **11**: 51–56. 15 Mr 1905; 65–68. 15 Ap 1905; 87–90. 15 My 1905; 108, 109. 15 Je 1905.

Latham, M. E. Stimulation of *Sterigmatocystis* by chloroform. Bull. Torrey Club **32**: 337–351. 29 Jl 1905.

Lawrence, W. H. Notes on the *Erysiphaceae* of Washington. Jour. Myc. **11**: 106–108. 19 Jl 1905.

Leavitt, R. G. & Spalding, L. J. Parthenogenesis in *Antennaria.* Rhodora **7**: 105. 1 Je 1905.

Lewis, I. F. Notes on the development of *Phytolacca decandra* L. Johns Hopkins Univ. Circ. **1905**[5]: 34–42. *f. 1–26.* My 1905.

Livingston, B. E. Physiological properties of bog water. Bot. Gaz. **39**: 348–355. *f. 1–3.* 20 My 1905.

Lloyd, F. E. The course of the pollen-tube in *Houstonia*: a preliminary study. Torreya **5**: 83–85. 25 My 1905.

Lyon, F. Another seed-like characteristic of *Selaginella.* Bot. Gaz. **40**: 73. 18 Jl 1905.

Lyon, H. L. Polyembryony in *Sphagnum.* Bot. Gaz. **39**: 365, 366. *f. 1–3.* 20 My 1905.

MacDougal, D. T. Botanical explorations in Arizona, Sonora, California, and Baja California. Jour. N. Y. Bot. Gard. **6**: 91–102. *pl. 27* + *f. 22–27.* Je 1905.

Maxon, W. R. *Adenoderris*, a valid genus of ferns. Bot. Gaz. **39**: 366–369. *f. 1, 2.* 20 My 1905.

With a description of *A. sororia* sp. nov. from Guatemala.

Meader, A. R. *Actinella odorata* in Maine. Rhodora **7**: 80. 14 Ap 1905.

Morgan, A. P. The genus *Gibellula* Cavara. Jour. Myc. **11**: 49, 50. 29 My 1905.
With a description of *G. capillaris* sp. nov.

Morgan, A. P. A new *Chaetosphaeria*. Jour. Myc. **11**: 105. 19 Jl 1905.
C. ludens sp. nov.

Murrill, W. A. The *Polyporaceae* of North America — XI. A synopsis of the brown pileate species. Bull. Torrey Club **32**: 353–371. 29 Jl 1905.
With descriptions of 6 new genera: *Flaviporus*, *Cerrenella*, *Nigroporus*, *Fomitella*, *Amauroderma*, and *Porodaedalea*.

Murrill, W. A. A trip to Cuba. Jour. N. Y. Bot. Gard. **6**: 111–115. Jl 1905.

Nash, G. V. *Podostemonaceae*. N. Am. Fl. **22**: 3–6. 22 My 1905.

Nash, G. V. A trio of grasses new to the West Indies. Torreya **5**: 109, 110. 24 Je 1905.

Nash, G. V. A trip to the Inaguas. Plant World **8**: 63–71. *f. 16–21.* [Ap] 1905; 91–98. *f. 23–25.* [My] 1905.

Nelson, A. Contributions from the Rocky Mountain Herbarium. VI. Bot. Gaz. **40**: 54–67. 18 Jl 1905.
New species are described in *Sphaerostigma* (5), *Oreocarya*, *Chrysopsis*, *Aster*, *Crepis*, *Gilia*, and *Amelanchier* (2).

Newcombe, F. C. Geotropic response at various angles of inclination. Ann. Bot. **19**: 311–323. Ap 1905.

Niles, G. G. Hoosac Valley and its flowers and ferns. Am. Bot. **9**: 1–7. Jl 1905. [Illust.]

Parish, S. B. Flowering of *Yucca australis*. Torreya **5**: 104, 105. 24 Je 1905. [Illust.]

Parish, S. B. *Ophioglossum californicum* in central California. Fern Bull. **13**: 48. [My] 1905.

Parish, S. B. A preliminary synopsis of the Southern California *Cyperaceae*. VIII. Bull. So. Calif. Acad. Sci. **4**: 66–68. 18 My 1905; — IX. Bull. So. Calif. Acad. Sci. **4**: 80–84. *pl. 11, 12.* 28 Je 1905.

Piper, C. V. The two eastern species of *Melica*. Bull. Torrey Club **32**: 383–387. 29 Jl 1905.

Rehm, H. *Ascomycetes* exs. fasc. 34. Ann. Myc. **3**: 224–231. 10 Jl 1905.
Includes the description of *Cryptomyces Leopoldinus* sp. nov., from Brazil.

Setchell, W. A. *Gymnogongrus Torreyi* (Ag.) J. Ag. Rhodora **7**: 136–138. 8 Jl 1905.

Shaw, C. H. Botanizing in British Columbia. Plant World **8**: 105–107. [My] 1905.

Shirley, H. A. Our summer's diversions [at Salem, N. C.]. Am. Bot. **8**: 64–67. [My] 1905.

Shreve, F. The development of *Sarracenia purpurea* L. Johns Hopkins Univ. Circ. **1905**[5]: 31–34. My 1905.

Small, J. K. *Rosales.* N. Am. Fl. **22**: 1, 2. 22 My 1905.
Character of the order and key to the families.

Smith, J. D. Undescribed plants from Guatemala and other Central American republics. XXVII. Bot. Gaz. **40**: 1–11. 18 Jl 1905.
Descriptions of 23 new species in 21 genera.

Snow, L. M. The development of root-hairs. Bot. Gaz. **40**: 12–48. *pl. 1 + f. 10–15.* 18 Jl 1905.

Squires, W. A. The rise and fall of the tumbleweeds. Am. Bot. **9**: 9–11. Jl 1905.

Streeter, S. G. A treasure spot of wild flowers. Plant World **8**: 76–78. *f. 22.* [Ap] 1905.

Sydow, H. & P. Novae *Fungorum* species — II. Ann. Myc. **3**: 185, 186. 10 My 1905.
Includes 3 new species from Utah.

Taylor, E. B. How and where ferns grow in Southwest Georgia. Fern Bull. **13**: 53–60. [My] 1905.

Taylor, E. B. Nature's engrafting. Torreya **5**: 108. 24 Je 1905.

Terry, E. H. *Dicksonia pilosiuscula* forma *schizophylla* in Vermont. Rhodora **7**: 99. 12 My 1905.

Terry, E. H. *Hieracium murorum* in Massachusetts. Rhodora **7**: 80. 14 Ap 1905.

Thaxter, R. Preliminary diagnoses of new species of *Laboulbeniaceae.* Proc. Am. Acad. Arts & Sci. **41**: 301–318. Jl 1905.
Descriptions of 28 new species in 12 genera, of which one is new: *Distichomyces.*

Thom, C. Some suggestions from the study of dairy fungi. Jour. Myc. **11**: 117–124. 19 Jl 1905.

Tilton, G. H. *Scrophularia leporella* at Willoughby. Rhodora **7**: 119. 1 Je 1905.

Toumey, J. W. Notes on the fruits of some species of *Opuntia.* Bull. Torrey Club **32**: 235–239. *pl. 9, 10.* 27 My 1905.

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Vol. 2, No. 4; price, 75 cents:

Wheelock, W. E. The genus *Polygala* in North America. Pages 109–132. 30 D 1891.

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Vol. 3, No. 3; not furnished separately:

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Vol. 4, No. 1; not furnished separately:

Underwood, L. M. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

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Vol. 4, No. 3; price, 50 cents:

Rusby, H. H. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, A. S. *Arachis hypogaea* L. Pages 275–296, *plates 83–85.* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, P. A. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

VOL. 32 SEPTEMBER, 1905 NO. 9

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BULLETIN

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TORREY BOTANICAL CLUB

SEPTEMBER, 1905

Phytogeographical explorations in the coastal plain of Georgia in 1904

ROLAND M. HARPER

In 1904 my field work was confined to the winter and spring months, in which I had not previously done any work in South Georgia. While collecting timber specimens for the Georgia State Museum I spent a month, from January 23 to February 23 inclusive, in the coastal plain, passing through the counties of Muscogee, Chattahoochee, Marion, Schley and Sumter in January, and Dooly, Wilcox, Irwin, Coffee, Appling, Ware, Clinch, Echols, Lowndes, Brooks, Thomas, Decatur, Miller, Early, Calhoun and Randolph in February. During this period flowering plants numbered *2039* to *2056* and about the same number of fungi and bryophytes were collected. At the same time I made many car-window notes on distribution, mainly of trees and evergreen shrubs.

After completing my work for the State I took the field again on March 25, and before the end of May made notes or collections in the following counties lying wholly or partly in the coastal plain: McDuffie, Columbia, Richmond, Burke, Screven, Bulloch, Emanuel, Jefferson, Washington, Wilkinson, Baldwin, Jones, Bibb, Houston, Twiggs, Laurens, Montgomery, Tattnall, Bryan, Chatham, Liberty, McIntosh, Glynn, Wayne, Pierce, Ware, Coffee, Berrien, Lowndes, Irwin, Wilcox, Dooly, Sumter, Webster, Stewart and Randolph, approximately in the order named. On this trip vascular plants numbered *2057* to *2080* were collected in March, *2081* to *2181* in April, and *2182* to *2232* in May. Seventeen numbers of mosses and thallophytes were collected at the same time.

[The BULLETIN for August (**32**: 397–449, *pl. 22*) was issued 28 Au 1905.]

On both trips, winter and spring together, I traveled about 2500 miles by rail * through the coastal plain, in order to examine as much of the region as possible in its vernal and prevernal aspects. At the same time about 250 photographs of coastal plain vegetation and scenery were taken, with three cameras.

The winter of 1903–4 was colder than usual in Georgia, and spring was consequently late. The first spring flower I noticed was *Alnus rugosa*, on January 23. *Acer rubrum* began to bloom in Coffee County about the first week in February, and *Pieris phillyreaefolia*, *Thyrsanthema semiflosculare* and an unidentified species of *Crataegus* in Lowndes County before the middle of the month. On the Chattahoochee River in Early County *Acer saccharinum* and two or three species of *Ulmus* were just past flowering on February 18, and *Luzula saltuensis* † was beginning to bloom in Randolph County on the 23d. But after April 1st there was no noticeable scarcity of flowers. On that date I found a *Utricularia*, a *Myriophyllum* and a *Potamogeton*, plants which one usually associates with summer, in bloom in Screven County. During the first month after the vernal equinox, before the leaves on the trees were full-grown, I spent most of the time in the Eocene region of the coastal plain, where mesophytic forests prevail (*e. g.*, in the counties of Richmond, Burke, Jefferson, Washington, Wilkinson, Twiggs and Houston), and the woods at that season were resplendent with *Aesculus Pavia*, *Cornus florida*, *Azalea nudiflora* and other characteristic spring-flowering trees and shrubs, much as in the Piedmont region (Middle Georgia) a little farther inland.

Toward the end of April I passed into and through the pine-barren region,‡ where shade and shade-loving plants are scarce, and the most conspicuous flowers do not appear until summer. On a visit to Tybee Island at the mouth of the Savannah River on April 30 I was rather surprised at the scarcity of flowers.

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* For over 600 miles of this I am indebted to the courtesy of the officials of five railroads, the Georgia, the Louisville & Wadley, the Macon, Dublin & Savannah, the Wadley & Mt. Vernon Extension, and the Georgia Southern & Florida, especially the last-named.

† See Bull. Torrey Club **32**: 154. 1905.

‡ In Georgia the Cretaceous and Eocene regions together constitute about one-fourth of the area of the coastal plain, and the pine-barrens nearly three-fourths.

There seemed to be none at all in the salt marshes, and on the dunes only *Oenothera humifusa*, a *Cakile* and a *Gnaphalium* were noticed in bloom. But in the "hammocks" (low sandy elevations in the salt marshes, covered with evergreen trees and shrubs) *Helianthemum corymbosum* and *Opuntia vulgaris* were in bloom and a *Juncus* and a *Sagina* had already discharged their seeds. On McQueen Island, a brackish marsh eight miles long, midway between Savannah and Tybee, the only flowers visible from the train were those of *Scirpus Olneyi*, a *Hymenocallis* and an *Iris*, and these only at the upper end of the island (where I got off on the way back and collected them).

Most of the places of interest visited in 1904 would have little significance for persons not familiar with coastal plain geography in general and that of Georgia in particular, but there are at least two localities which deserve mention here.

In the southeastern part of Houston County, particularly for two miles north of Grovania and about the same distance south of Elko, much of the surface is strewn with siliceous boulders, and as the topography is at the same time quite rugged, such land is ill adapted for agricultural purposes and still retains its primeval forests. These forests are typically mesophytic, as is usually the case in the upper fourth of the coastal plain, but the abundance of rocks gives them a much more decided Middle Georgia aspect than in most coastal plain forests. I passed through this rocky region on the 15th and 16th of April, about the time flowers are most numerous in such places, and was interested to see such species as *Botrychium virginianum*, *Phegopteris hexagonoptera*, *Stipa avenacea*, *Melica mutica*, *Arisaema triphyllum*, *Luzula campestris*, *Erythronium americanum*, *Vagnera racemosa*, *Uvularia perfoliata*, *Salomonia biflora*, *Medeola virginica*, *Trillium Hugeri*, *T. stylosum*, *Juglans nigra*, *Hicoria ovata*, *Quercus rubra*, *Hepatica triloba*, *Sanguinaria canadensis*, *Geranium maculatum*, *Nyssa sylvatica*, *Oxypolis rigidior*, *Asclepias variegata* and *Chrysogonum virginianum*, none of which range much farther south, while they are more frequent in Middle Georgia or farther north. But the coastal plain character of this region is unmistakably shown by the occurrence, in the same forests, of *Pinus glabra*, *Tillandsia usneoides*, *Uvularia floridana*, *Smilax pumila*, *Myrica carolinensis*, *Magnolia* *grandiflora*, *Acer floridanum*, *Leucothoë racemosa* and *Mesadenia ovata*.

The extent of this formation east and west is unknown, but I have not heard of the occurrence of anything of the kind in any other county. The age of the formation is not definitely known either, but is doubtless either Eocene or Oligocene.

Immediately north of the northernmost of these rocky areas, and perhaps also between them, is a region with strongly calcareous soil and outcrops of soft limestone, characterized by some or all of the following plants: *Taxodium distichum*, *Carex cherokeensis*, *Rhapidophyllum Hystrix*, *Arisaema Dracontium*, *Tillandsia usneoides*, *Trillium lanceolatum*, *Zephyranthes Atamasco*, *Juglans nigra*, *Hicoria ovata*, *Quercus hybrida*, *Q. acuminata*, *Morus rubra*, *Ulmus fulva*, *Crataegus* (several species), *Prunus americana*, *Cercis canadensis*, *Geranium maculatum*, *Ptelea trifoliata*, *Rhamnus caroliniana*, *Viola multicaulis*, *Bumelia lycioides*, *Spigelia marilandica*, and *Phlox divaricata*.

FIGURE 1. View in the rocky woods about a mile south of Elko, Houston County, April 16. Topography and vegetation rather exceptional for the coastal plain. *Polystichum acrostichoides*, *Hicoria glabra*, *Fagus americana*, *Nyssa sylvatica* and *Cornus florida* appear in the view, and the whole aspect of the place is much like that of many points in the Alleghanies and farther north.

This limestone formation seems to form a narrow belt extending from the vicinity of Sandersville through or near Beech Hill, Danville, Westlake,* and Tivola, to Perry and perhaps Marshallville. Some people living near it have an idea that it extends from North Carolina to Mexico, but this is certainly an exaggeration. In Houston County it is commonly known as "the limestone ridge," and is dreaded by farmers who have to haul loads across it in wet

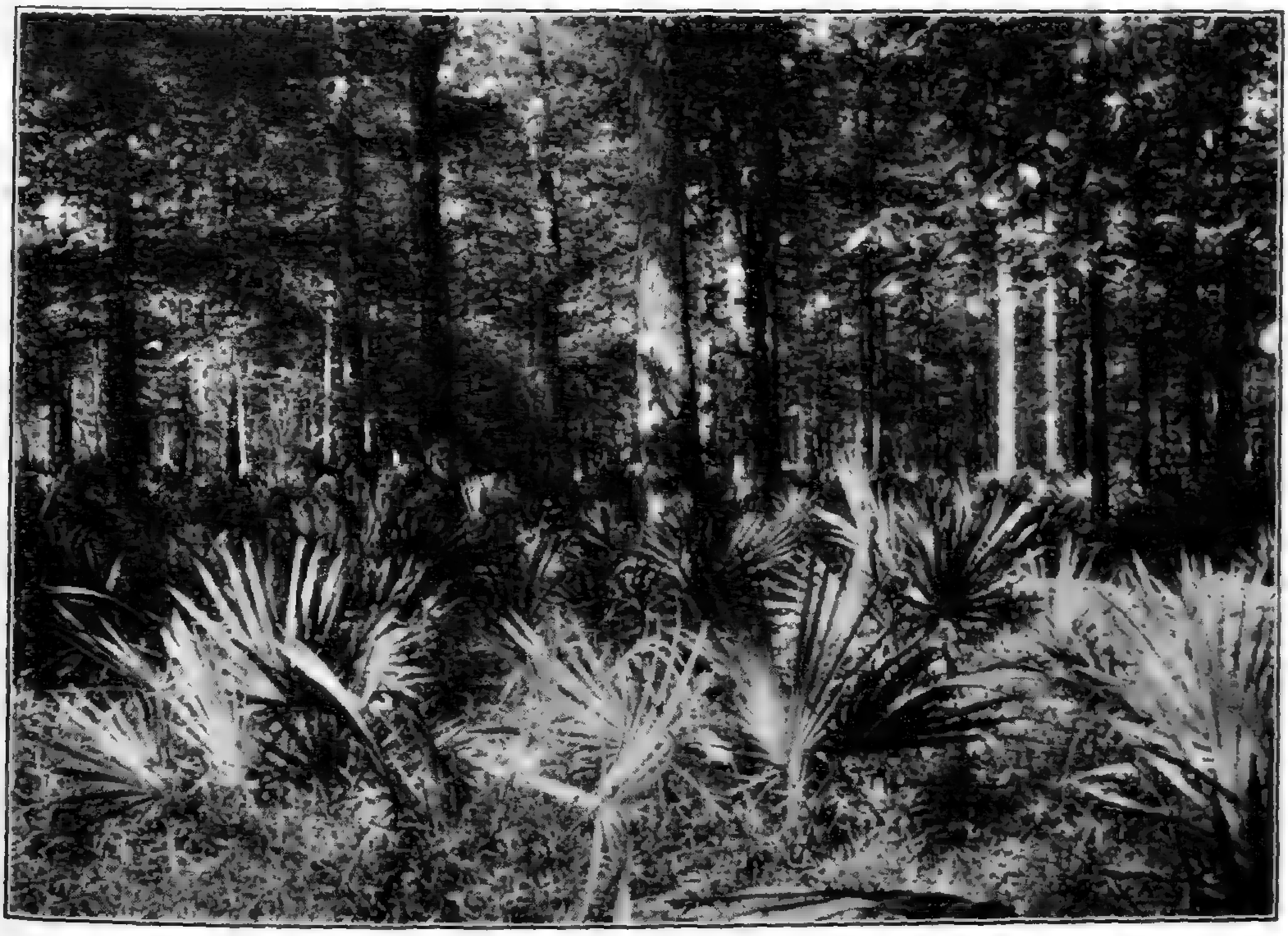

FIGURE 2. Swamp of Oconee River near Beech Hill, Wilkinson County, a point in the limestone belt here described. April 13. The trees are all deciduous, *Quercus Michauxii* being probably the most abundant. The Palmettos are *Sabal Adansonii* and *Rhapidophyllum Hystrix*, the former predominating. *Carex cherokeensis* and other species cover the ground. Shrubs are almost wanting.

weather. At other points where I have crossed it it is characterized by many of the same plants just mentioned, and may be traced by means of them in places where outcrops of the rock are wanting, as in the swamps of the Oconee and Ocmulgee rivers. (See FIGURE 2.) The limestone belt is approximately parallel with the inland edge of the pine-barrens, from which it is distant about ten miles. It is believed to be of Upper Eocene or Lower Oligocene age, but its stratigraphic relations with rocks of the same age else-

* See Bull. Torrey Club **32**: 162. 1905; under *Crataegus georgiana*.

where, and with the siliceous rocks just mentioned, are as yet very uncertain.

In Stewart County there is a remarkable area of genuine pine-barrens, which I first noticed in 1901,* and examined more carefully in the latter part of May, 1904. It is situated immediately south of Omaha, on a plateau which is bounded abruptly on the north by Hannahatchee Creek, and on the west by the Chattahoochee River bottoms, and is elevated something like 100 feet above both streams. The southern and eastern limits of the plateau have not been ascertained, but the pine-barrens occupy at least a square mile in the northwestern corner of it. What makes this pine-barren area remarkable is the fact that it is well within the Cretaceous region (having unmistakable exposures of Cretaceous rocks north, south, east and west of it) and is separated from the rest of the pine-barrens by the whole width of the Eocene and part of the Cretaceous, a distance of thirty or forty miles. Although *Pinus palustris*, the characteristic tree of the pine-barrens, is scattered more or less over the whole Cretaceous region of Georgia, yet nowhere else in that region have I seen it constituting the bulk of the forest as in the place here described. In the Eocene region it is still rarer, and one may go from Cuthbert twenty miles northward on the road to Lumpkin without seeing a single specimen of it, its place being taken there mostly by *P. echinata*.

The pine-barrens near Omaha are nearly level, and contain several ponds, at least one of which probably holds water all the year round. (See FIGURE 3.) The whole aspect of the place is much like that of some of the pine-barrens in the Lower Oligocene region (in Sumter County, for instance), and totally unlike that of the typical Cretaceous country, which is carved into broad valleys and rather narrow ridges, indicating a comparatively ancient topography. The long-leaf pines grow fully as large as they do anywhere, and I measured a stump of one which was 38 inches in diameter. The pines of low grounds are *P. serotina* and *P. Taeda*, instead of *P. Elliottii*, which ranges throughout the typical pine-barrens in similar situations. The following shrubs and herbs are common to this area and the typical pine-barrens, and are rare or wanting in the Eocene and the rest of the Cretaceous: *Anchistea vir-*

* See Bull. Torrey Club 30: 287, 325. 1903.

ginica, *Scirpus cylindricus*, *Xyris Smalliana*, *Eriocaulon compressum*, *Pontederia cordata*, *Pogonia divaricata*, *Brasenia purpurea*, *Polygala lutea*, *Hypericum fasciculatum*, *H. acutifolium*, *Rhexia glabella*, *Persea pubescens*, *Proserpinaca pectinata*, *Limnanthemum aquaticum*, *Vaccinium nitidum*, *Gratiola pilosa*, *G. ramosa*, *Monniera caroliniana*, *Utricularia purpurea*, *Houstonia rotundifolia*, *Viburnum nitidum*, *Sclerolepis uniflora* and *Sericocarpus bifoliatus*. Two of these, *Anchistea* and *Monniera*, are reported in Mohr's Plant Life of Ala-

FIGURE 3. "Alligator Pond," in the outlying pine-barrens near Omaha. May 24. The tree in the left foreground is *Pinus serotina*, and most of those in the distance are of the same species. *Pontederia cordata* conspicuous in the foreground. (For a list of some other species observed in the same pond, see Bull. Torrey Club 30: 325. 1903.) The demarcation between the pond vegetation and the surrounding shrubbery is much more abrupt here than in typical pine-barren ponds, and suggests the glacial lakes of the northern states.

bama as having been collected by Dr. E. A. Smith in the neighboring counties of Russell and Barbour in Alabama.

Now as for the cause of these outlying pine-barrens. The two superficial formations, Lafayette and Columbia, are present, as in the typical pine-barrens and most other parts of the coastal plain, but these rarely if ever determine the topography. The conclusion is irresistible that we have here between the Lafayette and Cretaceous strata an outlying patch of some Tertiary formation. Dr.

Smith suggests that it may be the Grand Gulf, which he finds to overlap a good deal of the Cretaceous and Eocene in Alabama; but the topography is not exactly that of the Altamaha Grit, which in Georgia corresponds to the Grand Gulf formation in Alabama and westward. Future explorations will probably settle this point.

The following plants of special interest were observed in South Georgia in 1904:

PELLAEA ATROPURPUREA (L.) Link

Collected on May 26 on limestone boulders in rich woods in the extreme northern part of Randolph County, about a mile from Grier's Cave (no. 2231), making one more species common to Pigeon Mountain in Northwest Georgia and the Midway Eocene region of Randolph County.* The general aspect of its surroundings is much the same at both places. No other coastal plain station for *Pellaea* seems to be known.

? SPARTINA JUNCIFORMIS Engelm. & Gray

On May 3, while approaching Brunswick, I saw from the train just outside of the city a quantity of an unfamiliar grass, and on investigating the next day I found it to be a *Spartina* (*no. 2187*), with slender erect stems 5 or 6 feet tall, growing in dense tufts of several hundred each. Its inflorescence is most like that of *S. junciformis*, a species of the Gulf coast, but it can hardly be that or any other described species. The leaves of my plant are concave, but not involute when fresh; and there is nothing in the existing descriptions of *S. junciformis* to indicate that it grows in such large tufts. (But probably most of these descriptions are drawn entirely from herbarium specimens, as is too often the case.) The habitat of my plant was very unusual for a *Spartina*, being a sort of combination of cypress (*Taxodium imbricarium*) pond and pine-barren stream, though probably only a few feet above tide-water. All the specimens seen were within about a hundred yards of each other.

SCIRPUS FONTINALIS Harper, Bull. Torrey Club **30**: 322. 1903

This species, previously known only from the type-locality in Sumter County, has turned up at two more South Georgia

*See Bull. Torrey Club **31**: 16. 1904.

stations, quite different from the type-locality as well as from each other. On April 16, I found a few specimens beginning to flower (*no. 2130*), around a spring in the rocky woods mentioned above, about two miles south of Elko in Houston County. On May 3, I collected it again in low woods near Thalmann, Glynn County, where it was more abundant (*no. 2185*). Here it was associated with *Sabal Palmetto, S. Adansonii, Cladium effusum, Itea virginica, Rubus nigrobaccus, Acer rubrum, Pieris nitida, Viburnum nudum*, and some other species which seemed strangely incongruous; while at the Houston County station some of its nearest neighbors were *Hepatica, Sanguinaria, Geranium*, and other familiar northern plants. The three known localities have probably at least one feature in common however, the absence of the Lafayette formation and consequently more or less calcareous soil.

The specimens of these later collections have culms ascending or nearly erect (not nodding as in the type), and shorter and less densely tufted than in the original specimens; no tendency to proliferation in the inflorescence was observed (though this may develop later in the season); and the type specimens were evidently somewhat abnormal in these respects. The new specimens seem to be just as distinct from related species as the old ones were.

CLADIUM MARISCOIDES (Muhl.) Torr.

This is probably common enough in the glaciated region of the North, but very few stations are known for it in the South.* Consequently I was rather surprised to find a good deal of it in a grassy cypress pond between Pinehurst and Unadilla in Dooly County on May 21 (*no. 2221*). It was then not quite in flower.

The leaves of this species are different from any others known to me, and I have never seen them correctly described. Toward the base they are channeled, and a cross section there would show a shallow trough with flat bottom and erect sides. Tapering upward, the leaf gradually folds inward on its midrib, and within an inch or so of the apex the margins (remaining about the same width) become completely united, giving there a triangular cross section.

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* See Rhodora **1**: 43, 98, 204; **2**: 123, 202; **5**: 133; **6**: 108; **7**: 72; also Mohr, Contr. U. S. Nat. Herb. **6**: 410. 1901

CAREX SQUARROSA L.

A few specimens were collected in the swamp of the Ocmulgee River at Barrow's Bluff (the present northern terminus of the Wadley and Mt. Vernon Extension R. R.), Coffee County, on May 14 (*no. 2204*). Its occurrence there is rather anomalous, for it had not previously been reported south of the mountains of Georgia; but it is unquestionably indigenous.

CAREX WALTERIANA Bailey (*C. striata* Michx.)

With *Cladium mariscoides* (see above), also in pine-barren ponds in Screven (*no. 2090*) and Irwin counties in the Altamaha Grit region. Seen in 1903 in the eastern part of Effingham County (*no. 1810*). Not at all common.

The perigynia of this species are described in Small's Flora, and perhaps elsewhere, as "purple-brown," but they are really pale-green, just as in most species with inflated perigynia.

CAREX sp.

On May 4, I collected in a cypress pond just outside of Brunswick some over-ripe specimens of a *Carex* (*no. 2186*) which does not seem to be provided for in modern books. I at once recognized it as a species I had often before seen in summer after its fruit had all fallen, and had never collected for that reason. I afterward saw it in a number of similar places in the pine-barren region. It is so common that it must have been seen by many botanists in the past, and it has probably been described, but it is practically impossible to decide what name, if any, should apply to it. I will describe it briefly here so that future monographers may recognize it and perhaps place it correctly. It is a near relative of *C. glaucescens* Ell. or *C. verrucosa* Muhl. (if these are synonymous; if they are not, it may be identical with one of them), but differs from the plants to which these names have been usually applied in having the pistillate spikes on stout nearly erect peduncles, and flowering always about three months earlier (*i. e.*, in March or April, like most *Carices* in that latitude).

CAREX CHEROKEENSIS Schw.

Seen on April 13 and 15 at two points in the limestone belt above mentioned, namely, in the Oconee River swamp near Beech

Hill, Wilkinson County (*no. 2116*), and in rich woods between Tivola and Beech Haven, Houston County. At the former station (see FIGURE 2) it and several of its congeners were quite abundant. This is one of the few *Carices* which shows a decided preference for calcareous soil. It does not seem to have been reported from the coastal plain of Georgia before (though I collected it in Sumter County in 1900), but it has long been known from the Palaeozoic region (Northwest Georgia), where it seems to have been first discovered.

In the description of the species in Small's Flora the word staminate is inadvertently used instead of pistillate, and in the key the descriptive phrase "Leaves pubescent" belongs to the northern representative of the group *Flexiles* (see Britton's Manual, page 206), and not to *C. cherokeensis.* This gave me some trouble in identifying it. The following characters might well be added to the existing descriptions of this very distinct species:— Rootstocks stout, elongated, horizontal, partly covered with the rigid persistent bases of the leaves; leaves smooth and shining, tough, purple at base.

CAREX RENIFORMIS (Bailey) Small

With or near several of its congeners (but perfectly distinct from any of them) in the swamp of the Ohoopee river near the center of Tattnall County, April 26 (*no. 2153*). Previously known only from Mississippi and Louisiana.

ERIOCAULON LINEARE Small, Fl. S. E. U. S. 236. 1903

This was one of the greatest surprises of the whole trip. It was originally described from a few specimens collected in wet woods in the pine-barrens in the upper part of Bulloch County in June, 1901; and I never saw a trace of it again until April and May of last year. Then I was astonished to find it one of the most abundant plants in moist pine-barrens in the Altamaha Grit region, growing in countless millions in Bulloch, Tattnall, Montgomery (*no. 2146*), Coffee, Wilcox, Irwin, Berrien, and doubtless many other counties. Its habitat is exactly that of the well known and larger *E. decangulare*, which is equally abundant and conspicuous during the summer months. *E. lineare* seems to flower only in April and May (the type specimens, collected early in June, were past their prime), and after that its scapes must disappear almost completely, and the leaves alone would attract no attention. When it is in flower *E. decangulare* can usually be found with it, but very immature and inconspicuous, and when the latter blooms the former is almost invisible. How such an abundant species as *E. lineare* could have been overlooked so long can be explained only on the supposition that it is nearly confined to the Altamaha Grit region, which up to last year had scarcely been explored in spring.*

FIGURE 4. *Eriocaulon lineare* in moist pine-barrens, Douglas, Coffee County. May 16. Two months later in the season *E. decangulare* can be found equally abundant on the same spot. (The pitcher-plants are *Sarracenia flava* in the background and *S. flava* × *minor* in the foreground.)

If the plant had ever been seen by other botanists it was probably mistaken for *Lachnocaulon anceps* or *Dupatya flavidula*, which often grow with it and are about the same size. In its own genus it is probably nearest related to *E. compressum*, a considerably larger plant which flowers still earlier, in March and April, and grows almost always in pine-barren ponds. *E. septangulare* is nearer to it in size, but is rare in the South, growing on sandy margins of ponds and flowering in late summer.†

With more copious material at hand, the resemblance of *E.*

* See Bull. Torrey Club 32: 142. 1905.

† See Bull. Torrey Club 31: 14. 1904.

lineare to a plant from Sumter County (*no. 1395*) which I had distributed in my 1902 collection as *E. texense* Koern.* seemed very strong, so on May 21 I revisited that locality and collected some more specimens (*no. 2219*) on the same spot. These proved to be *E. lineare*, as I suspected; so *E. texense* seems to be known only from the original collection, after all.

I notice an unfortunate typographical error in the original description of *E. lineare*. At the end of the first line, "alternate" should be "attenuate" (referring, of course, to the apex of the leaf).

ALETRIS OBOVATA Nash; Small, Fl. S. E. U. S. 286. 22 Jl 1903
(Described more fully in Torreya **3**: 101, 102. 25 Jl 1903)

This is the common if not the only white-flowered *Aletris* in the Altamaha Grit region. In May I saw it in the counties of Ware, Coffee (*no. 2201*), Wilcox, Irwin and Berrien, in rather dry pine-barrens. It was previously known only from the type-locality in northeastern Florida.

Dr. Chapman describes the flowers of both *A. aurea* and *A. farinosa* as either white or yellow, but it is now pretty evident that his yellow *farinosa* was *A. lutea* Small,† and his white *aurea*, *A. obovata* Nash; so the description of these two newer species has considerably facilitated our understanding of the genus. Like *A. lutea*, which often grows with it, and blooms at the same time, *A. obovata* differs from *A. farinosa* in range and from *A. aurea* in time of flowering.

With *A. lutea* and *A. obovata* at the place where I collected the latter (near Douglas) were a few specimens intermediate in appearance, probably hybrids.

HYMENOCALLIS sp.

At the end of April a *Hymenocallis* (*no. 2179*) in full bloom was conspicuous in the brackish marshes at the upper end of McQueen Island in Chatham County, about five miles from Savannah by the Tybee Railroad. It had only one or two flowers, usually two, on each scape, and the leaves were only about 2 cm. wide. This plant seems to have been known to LeConte, Feay,

* See Bull. Torrey Club **31**: 20. 1904.

† See Bull. Torrey Club **32**: 154. 1905.

and some of their predecessors, but in the present state of the literature bearing on the genus it is difficult to decide whether it has ever received a tenable name. It is certainly distinct from a species which grows in shady swamps in the Lower Oligocene region and has broad leaves and three or four flowers, blooming in July; but there are probably not more than three species of *Hymenocallis* in the southeastern states outside of Florida, and one of them is very

FIGURE 5. *Hymenocallis* sp. in Seventeen Mile Creek, Coffee County. May 12. The creek was very nearly dry at the time, but water often covers this spot.

local, growing only along the fall-line. These three species are recognized in Mohr's Plant Life of Alabama, but it is not certain that they are correctly named there. The study of this genus is complicated by the fact that some species are said to produce more flowers in cultivation than in the wild state, and several of them were first described from cultivated specimens.

What seems to be exactly the same plant was seen in a creek swamp in Coffee County in May, and the illustration of it subjoined (FIGURE 5) may enable some future monographer to determine the species.

QUERCUS GEMINATA Small, Bull. Torrey Club **24**: 438. 1897

This has been known hitherto only as a shrub or small tree, ranging from Florida to Mississippi. While collecting timber specimens in the winter I had occasion to study the live-oaks on the sand-hills of the Altamaha Grit region, and found them to be all of this species. In Coffee County (*no. 2050*) it is sometimes thirty feet tall, with a trunk two feet in diameter, which when full grown is never erect, but ascending or curved.

Its distribution has not been well worked out yet, but it can probably be found in every county in the lower half of the coastal plain of Georgia. *Q. virginiana*, with which it was formerly confused, seems to be confined to the immediate vicinity of the coast and to the lime-sink region (which are just the regions where *Tillandsia usneoides* grows most luxuriantly). These two oaks are not as distinct as one might wish, however, and on Tybee Island I have seen specimens which might be referred about equally well to either.

CLAYTONIA VIRGINICA L.

In the swamp of the Oconee River near Beech Hill, Wilkinson County (see FIGURE 2), April 13 (*no. 2120*). This is the only place where I have seen it in the South. Its habitat is certainly very different there from what it is in New York City, where it is almost a weed.

SAGINA DECUMBENS SMITHII (Gray) Wats.

What seems to be this little-known plant was collected in a hammock (see page 453) on Tybee Island on April 30 (*no. 2175*). It was past flowering, but was readily distinguishable from *S. decumbens* by its almost simple, strictly erect, purple stems. It was previously known only from the coastal plain of New Jersey, and adjacent Pennsylvania.

There are a number of plants on the sea islands of Georgia, growing in apparently perfectly natural places, whose indigeneity* is doubtful, and this is one of them.

MAGNOLIA ACUMINATA L.

Collected in rich woods at the extreme coastward edge of the Cretaceous region, about two miles northwest of Lumpkin, May 25 (*no. 2227*). I saw only one tree, but was informed by a native that there is a good deal of it in the vicinity, and that its wood is a favorite material for hoe-handles.

SAXIFRAGA VIRGINIENSIS Michx.

On sandstone rocks on a bluff along McBean Creek in the southeastern corner of Richmond County, March 26, in flower (*no. 2061*). This station is in the Eocene region, about twelve miles below the fall-line, and seems to be the only one known for this species in the coastal plain.

DIRCA PALUSTRIS L.

On the sandy bank of the Oconee River opposite Dublin, Laurens County April 20 (*no. 2136*). This locality was pretty well exposed to the sun, and is rather a remarkable one for a species which in New England prefers the coolest and shadiest places.

AESCULUS PARVIFLORA Walt.

In rich shady woods at two or three places between Lumpkin and Omaha, in Stewart County, in the Cretaceous region, May 24 and 25, with flower-buds very immature (*no. 2225*). I do not know of any other station in Georgia for it. The habitat and time of flowering given for this species by Chapman and Small seem to need some revision.

POLYCODIUM REVOLUTUM Greene, Pittonia **3**: 325. 1898

On the sand-hills of the Allapaha River in the northeastern part of Berrien County, May 5 (*no. 2191*). A shrub about 6 feet tall, copiously branched. Previously known only from the type-locality in Lake County, Florida. This species is not mentioned

* I do not find this word in the dictionaries, but it appears in the *Journal of Botany* for March, 1905 (page 90), if not elsewhere, and there seems to be no other word to express the same idea.

in Small's Flora, but seems as distinct as any of those into which this little genus has recently been divided.

LEPTOPODA HELENIUM Nutt. Gen. **2**: 174. 1818

Frequent in moist pine-barrens and shallow ponds in various parts of the coastal plain, flowering in April and May. Collected in Bulloch (*no. 2167*) and Sumter (*no. 2213*) counties. This certainly seems generically distinct from *Helenium*, in which it has been placed by many authors; but I am unable so far to distinguish more than one species of *Leptopoda*.

COLLEGE POINT, NEW YORK.

The Polyporaceae of North America — XII. A synopsis of the white and bright-colored pileate species

William Alphonso Murrill

A synopsis of species with brown context was given in article XI of this series. The present paper deals with the genera and the principal described species having a white or bright-colored context and a distinct pileus. The species of certain genera are so numerous that they must form the subject of a separate article.

Subfamily 1. POLYPOREAE

It is not always possible to draw a distinct line of cleavage in this group. *Microporellus*, for example, has sessile forms which are thin and multizonate; *Funalia*, while usually brown, has some nearly white variations, and *Polyporus arcularius*, *Polyporus Polyporus* and *Polyporus caudicinus* have tubes very similar to those of *Hexagona*.

In distinguishing the subfamilies, also, certain species of *Fomes* are annual at times, while normally annual plants may assume a perennial appearance under favorable conditions. Poroid forms of *Agaricus* are always liable to confuse the beginner. The classification here adopted is acknowledged to be imperfect and artificial, but it is hoped that it will lead to something better when our knowledge of the plants treated is more complete.

Synopsis of the Polyporeae with white context

Hymenophore sessile.
- Tubes hexagonal, arranged in radiating rows; context thin. 1. *Hexagona.*
- Tubes alveolar; context thin, dry, surface zonate. 2. *Favolus.*
- Tubes mostly shallow, marginal and obsolete; hymenium hydnoid or irpiciform at a very early stage. 3. *Irpiciporus.*
- Tubes normally poroid, sometimes irpiciform from the rupture of the dissepiments at maturity.
  - Hymenium at length separating smoothly from the context. 4. *Piptoporus.*
  - Hymenium not separating as above.
    - Pileus very soft, spongy and elastic throughout.
      - Hymenophore of immense size; tubes small, fragile when dry. 5. *Dendrophagus.*
      - Hymenophore small; tubes large, not fragile. 6. *Spongiporus.*

Pileus more or less firm, flexible or rigid.
Context duplex, spongy above, firm below; surface sodden and bibulous. 7. *Spongipellis.*
Context not duplex as above.
Pileus fleshy-tough to woody and rigid; surface rarely zonate.
Surface anoderm.
Hymenium more or less smoke-colored at maturity. 8. *Bjerkandera.*
Hymenium white or pallid.
Context fleshy to fleshy-tough, friable when dry. 9. *Tyromyces.*
Context punky to corky, not friable when dry. 10. *Trametes.*
Surface pelliculose; plants chiefly tropical.
Plants small, 5 cm. or less in diameter. 11. *Rigidoporus.*
Plants large, more than 5 cm. in diameter.
Hymenium flesh-colored. 12. *Earliella.*
Hymenium white or pallid. 13. *Cubamyces.*
Pileus thin, leathery and more or less flexible; surface usually zonate.
Hymenophore preceded by a cup-shaped sterile body. 14. *Poronidulus.*
Hymenophore not as above.
Hymenophore normally pileate; tubes small and regular. 15. *Coriolus.*
Hymenophore semi-resupinate; tubes irregular. 16. *Coriolellus.*
Hymenophore stipitate.
Stipe compound. 17. *Grifola.*
Stipe simple.
Plants fleshy, terrestrial. 18. *Scutiger.*
Plants tough, epixylous.
Tubes large, hexagonal and radially elongated from the first. 1. *Hexagona.*
Tubes not as above.
Pileus inverted, erumpent from lenticels. 19. *Porodiscus.*
Pileus erect or lateral, not erumpent.
Context duplex, spongy above, woody below. 20. *Abortiporus.*
Context homogeneous, firm.
Surface zonate. 21. *Microporellus.*
Surface azonate. 22. *Polyporus.*

1. HEXAGONA Pollini, Pl. Nov. 35. *pl. 2, 3.* 1816

Type: *Hexagona Mori* Pollini.

Hymenophore small, annual, epixylous, flabelliform to reniform, rarely circular, stipitate, the stipe sometimes much reduced;

surface smooth or tessellated, margin thin; context thin, white, fibrous, fleshy to tough, usually fragile when dry; hymenium of radiating rows of large, thin-walled, hexagonal tubes, usually radially elongated; spores smooth, hyaline.

Species: *H. alveolaris* (DC.) Murr., *H. micropora* Murr., *H. daedalea* (Link) Murr., *H. Wilsonii* Murr., *H. hispidula* (B. & C.) Murr., *H. princeps* (B. & C.) Murr., *H. fragilis* Murr., *H. floridana* Murr., *H. tessellatula* Murr., *H. caperata* (Pat.) Murr., *H. brunneola* (B. & C.) Murr., *H. purpurascens* (B. & C.) Murr., *H. portoricensis* Murr., *H. hondurensis* Murr., *H. indurata* (Berk.) Murr., *H. cucullata* (Mont.) Murr., *H. Taxodii* Murr. [See Bull. Torrey Club **31**: 325–333. 1904.]

2. FAVOLUS Beauv. Fl. Owar. **1**: 1. *pl. 1.* 1805

Type: *Favolus hirtus* Beauv.

Scenidium Kuntze, Rev. Gen. 515. 1893. Type: *Favolus hirtus* Beauv.

Hymenophore small, annual, epixylous, sessile, dimidiate or reniform; surface multizonate, margin thin; context thin, leathery, pallid or brown; tubes alveolar; spores smooth, hyaline.

Species: *F. tenuis* (Hook.) Murr., *F. variegatus* (Berk.) Murr. [See Bull. Torrey Club **32**: 99–103. 1905.] The first species is usually white in substance, the other brown.

3. **Irpiciporus** gen. nov.

Type: *Irpex mollis* B. & C.

Hymenophore annual, epixylous, sessile, effused-reflexed, white or pallid throughout; surface anoderm, glabrous or velvety, not distinctly zonate, margin acute; context white, coriaceous or corky; hymenium hydnoid or irpiciform with traces of shallow obsolete tubes near the margin; spores smooth, hyaline.

Synopsis of the North American species

Teeth a centimeter or more in length; pileus often large and thick. *I. mollis.*
Teeth one-half a centimeter or less in length; pileus thin and shortly reflexed. *I. Tulipiferae.*

Irpiciporus mollis (B. & C.)

Irpex mollis B. & C. Hook. Jour. Bot. **1**: 236. 1849.

Irpex crassus B. & C. Hook. Jour. Bot. **1**: 236. 1849.

Described under the former name from Ravenel's collections in South Carolina and under the latter lower down on the same page from plants collected by Curtis high up on the trunk of a living oak in North Carolina. The distinct zones on the context appear to accompany luxuriant growth, being present in very large plants known by Berkeley as *I. crassus.*

This species is often met with upon decaying wood of oak, locust, apple and various other deciduous trees throughout temperate North America.

New York, *Cook;* New Jersey, *Ellis;* Virginia, *Murrill;* Georgia, *Harper;* Florida, *Calkins, Lloyd;* Ohio, *Morgan;* Michigan, *Pieters.*

Irpiciporus Tulipiferae (Schw.)

Boletus Tulipiferae Schw. Syn. Fung. Car. 73. 1818.
Irpex Tulipiferae Fr. Epicr. 523. 1838.

Described from Schweinitz' Carolina collections on dead trunks of *Liriodendron*, as follows:

"B. P. maxima effusa margine involuto tenui albida, poris maximis acutis prominulis asperis irregularibus."

This species is considered by many the same as *I. sinuosus* Fr. (Elench. Fung. 145. 1828), described from specimens observed for several years on fallen oak branches in Sweden and others sent from Ruthenia by Weinmann. Bresadola goes further and adds *I. lacteus* Fr., *I. canescens* Fr. and *I. Bresadolae* Schulz. to the list of synonyms. In any case, Schweinitz' name is the oldest.

This is one of the commonest fungi in our woods, the thin effused pilei often extending the whole length of branches, and even entire trunks, of dead deciduous trees of all kinds. A few collections are as follows:

Canada, *Macoun;* New York, *Peck, Shear, Britton;* Pennsylvania, *Sumstine, Murrill;* New Jersey, *Ellis, Britton, Murrill;* Virginia, *Murrill;* Tennessee, *Murrill;* Ohio, *Selby, Morgan;* Missouri, *Demetrio;* Kansas, *Bartholomew;* Wisconsin, *Baker;* Mexico, *Egeling.*

SPECIES INQUIRENDAE

IRPEX PALLESCENS Fr. Epicr. 522. 1838. Described from plants collected by Schweinitz in North America on trunks of *Liriodendron.*

4. PIPTOPORUS Karst. Rev. Myc. **3**[9]: 17. 1881

Type: *Boletus betulinus* Bull.

Hymenophore annual, epixylous, umbonate-sessile; surface smooth, azonate, pelliculose; context white, fleshy-tough; hymenium at length separating smoothly from the context, tubes white, thick-walled; spores smooth, cylindrical, hyaline.

Species: *P. suberosus* (L.) Murr. [See Bull. Torrey Club **30**: 424, 425. 1903.]

5. **Dendrophagus** gen. nov.

Type: *Polyporus Colossus* Fr.

Hymenophore very large, but of light weight, annual, epixylous, sessile, dimidiate, thick and pulvinate; surface pelliculose, glabrous, azonate, margin very obtuse; context very thick, soft and spongy throughout; tubes small, dark-colored, thin-walled, fragile; spores smooth, hyaline.

Dendrophagus Colossus (Fr.)

Polyporus Colossus Fr. Nov. Symb. 56. 1851.

Described from material collected by Oersted on stumps of *Cedrela odorata* at Puntarena in Costa Rica as follows:

"Pileo floccoso-suberoso molli crasso pulvinato, *margine tumido obtusissimo*, primitus cuticula tenella laevi vernicea sulfurea tecto, eaque secedente scabroso, contextu stuppeo mollissimo alutaceo-pallescente, poris minutis elongatis mollibus, intus fuscescentibus."

"Portentum mirabile et magnitudine et ponderis levitate. Fungus dimidiatus, sessilis, reniformis sed undulatus, crassimus (3–4 unc.) etiam in margine obtusissimo, contextu stuppeo-fomentario (nullo modo fibroso ut in Spongiosis), mollissima, alutaceo-pallida l. isabellina. Pileus extus quoque mollissimus, ut digito pressus foveas relinquat persistentes, undulatus, more *P. betulini* tectus cuticula laevi vernicea arcte adnata citrina, et in hoc statu pileus politus apparet, at cuticula secedente scabrosus evadit et decolorans. Pori valde longi et densi, absque trama discolori et a pileo separabiles, ore minuto, exsiccati nigrescentes, intus fuscescentes; in vivo enim admodum molles et hinc in exsiccatis confluunt in callum nigricantem absque poris extus conspicuis. Ad truncos ins. *San Jan* Indiae occid. lectus est fungus aeque giganteus, textura eadem, modo obscurior et pondere gravior; sed pileus epelliculosus, scabrosus, nigrescens. Pro forma prioris exoleta habeo."

Plants collected by Millspaugh, *no. 57838*, in Yucatan, appear to be immature specimens of the above species. Oersted's original plants are still preserved at Upsala. Further tropical exploration will doubtless discover more of this remarkable species.

6. **Spongiporus** gen. nov.

Type: *Polyporus leucospongia* Cooke & Hark.

Hymenophore small, annual, epixylous, sessile, dimidiate, pulvinate; surface white, anoderm to subpelliculose, azonate, soft and elastic; context white, extremely soft and spongy throughout; hymenium rigid, somewhat discolored, tubes large, irregular, thin-walled, lacerate; spores smooth, hyaline.

Spongiporus leucospongia (Cooke & Hark.)

Polyporus leucospongia Cooke & Hark. Grevillea **11**: 106. 1883.

This species was described from plants collected by Harkness at an altitude of 2,400 meters in the Sierra Nevada Mts., California, in 1882, growing upon decaying pine and spruce logs. Plants sent to Ellis under the name of *P. labyrinthicus* Schw. were forwarded to Cooke, who said they were clearly not *P. labyrinthicus* and suggested that they be described as new under the name of *Polyporus leucospongia*, an eminently appropriate name, since the whole pileus is pure white and as soft as a delicate sponge when young. Specimens have since been several times collected in Colorado by Bethel at about 3,600 meters on coniferous logs projecting from the snow. In such localities, he says, the plant is common, covering the ends of all such projecting logs. Crandall has also found it in Colorado and Nelson in Wyoming.

In Saccardo's Sylloge this species is queerly mixed with *P. labyrinthicus*, an error which clearly originated at Kew, for the sheet containing specimens of *P. labyrinthicus* labeled "U. S., C. B. Plowright" contains also at the bottom two packets of *P. leucospongia* from Harkness, *no. 1012*, collected in California on *Pinus contorta* and sent, as we know, under the name of *P. labyrinthicus*.

7. SPONGIPELLIS Pat. Hymén. Europ. 140. 1887

Type: *Spongipellis spumeus* (Sow.) Pat.

Postia Karst. Rev. Myc. 3^9: 17. 1881. (Not *Postia* Boiss. & Blanch. 1875.) Type: *Polyporus borealis* Fr.

Hymenophore annual, epixylous, sessile, dimidiate, simple or imbricate, rather large; surface white, anoderm, sodden and bibulous; context white, duplex, spongy above, firm below; hymenium concolorous, tubes thin-walled; spores smooth, hyaline.

Synopsis of the North American species

Context coarsely fibrous; tubes medium; plant common on coniferous wood. *S. borealis.*

Context finer; tubes smaller; plant found on deciduous wood. *S. galactinus.*

SPONGIPELLIS BOREALIS (Fr.) Pat. Tax. Hymén. 84. 1900

Polyporus borealis Fr. Syst. Myc. **1**: 366. 1821.

Described from material collected on trunks of *Abies* in the mountains of Smoland as follows:

"P. albus, pileis fibroso-suberosis mollibus subvillosis, demum subfulventibus, poris tenuibus inaequalibus.

"Recens inodorus, siccus odorem aniseum debilem spargit. Imbricatus, subconcrescens, 2 unc. & ultra latus & crassus, superne convexus, nunc velutinus, nunc strigosus, margine acuto, subtus planus. Pori albi, lacerati, sinuoso & subrotundi, angustissimi, tubulos longos formant."

In the Elenchus, Fries separates two varieties, *montanus* and *spathulatus*, and notes that the species is extremely abundant on fir trunks in the mountains of Omberg.

This plant, although well known in Europe and fairly common in the northern parts of America, is still very imperfectly known by many of the botanists and most of the collectors in this country. It occurs on coniferous trees only, being found most frequently in America on the hemlock. Much more needs to be learned of its distribution. From what is known of it in Europe, one would expect to find it throughout North America as far south as Virginia, but American collections are very meager, as the following will show:

Finland, *Karsten;* Sweden, *Romell;* Germany, *Allescher;* Tyrol, *Bresadola;* Scotland, *Berkeley;* Canada, *Dearness;* New York, *Cook, Atkinson, Murrill, Mrs. Livingston;* Pennsylvania, *Gentry, Stevenson.*

SPONGIPELLIS GALACTINUS (Berk.) Pat. Tax. Hymén. 84. 1900

Polyporus galactinus Berk. Lond. Jour. Bot. **6**: 321. 1847.

Collected by Lea on rotten trunks near Waynesville, Ohio, in the autumn of 1844 and thus described by Berkeley:

"Pileus 2–3 inches broad, $1\frac{1}{2}$ inch long, dimidiate or reniform, and elongated behind, convex uneven, milk-white, clothed with strigose down of a soft, fleshy substance, zoned within and consisting of radiating fibers.

"Hymenium flat, or slightly concave. Pores $\frac{1}{100}$ of an inch broad, scarcely visible to the naked eye, but giving to the hymenium a silky lustre, white; dissepiments very thin, slightly uneven.

"Nearly allied to *Pol. undulatus* Schwein, and *Pol. symphyton* Schwein. The dried specimens are rigid, and sometimes have the margin dark brown."

This species was determined by Cooke as *P. borealis* and is usually seen under that name in collections. It may be distinguished by its smaller tubes, its less fibrous context and its habit of growing on deciduous instead of coniferous trees. One of its favorite hosts is the apple-tree, on which it has several times been found in New York and Connecticut, growing inside partially decayed trunks or emerging from knot-holes in living trees. When fresh it is pure white or watery white and so full of water that this may be squeezed out as from a sponge. On drying, it usually assumes a sordid tint, especially near the margin.

Specimens are at hand from Canada, *Dearness;* Massachusetts, *Underwood;* Connecticut, *Earle*, *Miss White;* New York, *Underwood, Earle, Stewart, Peck, Banker;* Delaware, *Commons;* Ohio, *Morgan, Lloyd.*

SPECIES INQUIRENDAE

BOLETUS UNDULATUS Schw. Syn. Fung. Car. 70. 1818. *Polyporus undulatus* Fr. Elench. Fung. 87. 1828. Described by Schweinitz from Carolina as follows:

"B. major subimbricatus spongiosus lutescens, pileo undulato hirto margine zonato, poris minutis candidis. Elegans fungus ad truncos rarius occurrit, in longitudinem expansus, interdum fere substipitatus, aetate indurescens. Pileus basi incrassatus, strigoso hirtus, margine substrigosus."

Fries makes the following comments on this species in the Elenchus:

"Major in longitudinem extensus, interdum postice porrectus, junior spongiosus, aetate indurescens. Pilei basi incrassati, strigoso-hirti ex Auctore, sed in meo Specimine tantum rugosi et quoad colorem fumosi. Pori minuti, obtusi, integri, in meo specimine sordidi. Caro crassa, fibrosa, subzonata, albida. Mihi *P. fumoso* proximus visus indeque hoc loco collocatus."

TRAMETES MALICOLA B. & C. Jour. Acad. Sci. Phila. II. **3**: 209. 1856. Described from specimens collected by Schweinitz on the trunk of an apple-tree at Bethlehem, Pennsylvania, and determined by him as *P. populinus* Fr., being *no. 366* in his synopsis. When his herbarium was examined by Berkeley and Curtis, this species was described as new as follows:

"Imbricatus, ligneus; pileis dimidiatis posticé decurrentibus subvillosis subzonatis, ligneo-umbrinis; poris mediis dissepimentis crassis subtomentosis."

8. BJERKANDERA Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 38. 1879

Type: *Polyporus adustus* Fr.

Merisma Gill. Champ. Fr. **1**: 688. 1878. (Not *Merisma* Persoon.) Type: *Boletus imberbis* Bull.

Myriadoporus Peck, Bull. Torrey Club **11**: 27. 1884. Type: *Myriadoporus adustus* Peck.

Hymenophore annual, epixylous, sessile, anoderm, glabrous, azonate, corky; context white, tough or woody, not friable when dry; tubes thin-walled, more or less smoke-colored, mouths polygonal; spores smooth, hyaline.

The species of *Bjerkandera* will be treated in a future paper.

9. TYROMYCES Karst. Rev. Myc. 3^9: 17. 1881

Type: *Polyporus chioneus* Fr.

Leptoporus Quél. Ench. Fung. 175. 1886. (Not *Leptopora* Raf. 1809.) Type: *Polyporus tephroleucus* Fr.

Oligoporus Bref. Unters. **8**: 114. *pl. 7. f. 12–22.* 1889. Type: *Oligoporus farinosus* Bref.

Hymenophore annual, epixylous, sessile, anoderm, azonate, glabrous or nearly so; context white, fibrous, fleshy to fleshy-tough, rigid and friable when dry; tubes thin-walled, white or yellowish, mouths polygonal; spores smooth, hyaline.

The species of *Tyromyces* will be treated in a later number of this series.

10. TRAMETES Fr. Gen. Hymen. 11. 1836.

Type: *Polyporus suaveolens* L.

Hymenophore annual, epixylous, sessile; surface anoderm, white, azonate; context white, homogeneous, coriaceous to soft-corky; hymenium concolorous, rigid, tubes thin-walled, mouths circular to irregular; spores smooth, hyaline.

The species of this genus will be considered in a later paper.

11. **Rigidoporus** gen. nov.

Type: *Polyporus micromegas* Mont.

Hymenophore annual, at times reviving, epixylous, sessile, dimidiate, conchate, simple or imbricate; surface pelliculose, multizonate, margin thin, incurved when dry; context thin, white, woody, very rigid when dry, tubes minute, regular, light-brown, mouths pruinose when young; spores smooth, hyaline.

Rigidoporus micromegas (Mont.)

Polyporus micromegas Mont. Pl. Cell. Cuba 423. 1842.
Polyporus plumbeus Lév. Ann. Sci. Nat. III. Bot. **5**: 136. 1846.
Polystictus rufopictus Cooke, Grevillea **15**: 23. 1886.

Besides the above names, assigned to Cuba and Guadeloupe specimens, there are several manuscript names and doubtless others in publication which refer to the same species.

This plant has been generally known under the name of *P. zonalis* Berk., described from König's Ceylon collections (Ann. Mag. Nat. Hist. **10**: Suppl. 375. *pl. 10. f. 5.* 1843). It is exceedingly common in tropical America and in the states bordering the Gulf of Mexico, occurring usually during wet weather on water-soaked logs of various species of palms and other broad-leaved trees. It is very rigid when dry and the pores are almost invisible. Some of the more recent collections are here mentioned.

Cuba, *Earle, Underwood, Murrill;* Jamaica, *Earle, Underwood;* Porto Rico, *Earle, Wilson;* Florida, *Ricker;* Louisiana, *Langlois;* Alabama, *Underwood, Earle.*

12. **Earliella** gen. nov.

Type: *Earliella cubensis* sp. nov.

Hymenophore medium to large, annual, epixylous, semi-resupinate, thin and dry but rigid; surface pelliculose, glabrous, zonate, more or less reddish-brown in color; context white, coriaceous, zonate; hymenium flesh-colored, tubes medium, irregular, becoming thin-walled; spores smooth, hyaline.

Earliella cubensis sp. nov.

Pileus annual, often reviving, semi-resupinate, laterally extended, conchate, imbricate, 3–6 × 5–15 × 0.2–0.5 cm.; surface thinly encrusted, glabrous, rugose, zonate, dark reddish-brown behind, or leaving a white marginal band 3–12 mm. in width; margin tumid, at length thin, undulate or lobed, fertile; context white, coriaceous, concentrically zonate; tubes 2–3 mm. long, 2–4 to a mm., white within, the mouths deep reddish-flesh-colored, fading to white, dissepiments at first thick, at length becoming thin and irregular with wavy edges; spores ellipsoidal, smooth, hyaline, 3–4 × 5–6 μ, cystidia none.

The type plants of this species were collected by Earle and Murrill (*no. 193*) near Herradura, Cuba, March 11, 1905. They grew on a decayed fallen deciduous log in rather moist woods. The species was collected also in the central and eastern parts of Cuba, and appears to be fairly well distributed and quite abundant in the island. It is known also from Jamaica and Central America. Berkeley identified the plant as *Polystictus Persoonii* Fr., which is the same as *Daedalea sanguinea* Kl. (Linnaea **8**: 481. 1833), described from Wight's collections in the East Indies. I have this latter plant from Hawaii, China, Africa and Australia, and there is a close resemblance between it and the American plant, but I think the two are sufficiently distinct. If *P. rudis* Lév. were better known it might prove to be an earlier name for the American species in question.

Cuba, *Earle & Murrill 104, 193, 204, 584*; Jamaica, *Earle 489*; Mexico, *C. L. Smith*; Nicaragua, *Shimek*.

SPECIES INQUIRENDAE

POLYPORUS RUDIS Lév. Ann. Sci. Nat. III. Bot. **5**: 133. 1846. *Polyporus subfulvus* Cooke, Trans. Bot. Soc. Edinburgh **13**: 153. 1878. Described from plants collected by Lherminier on trunks in the island of Guadeloupe as follows:

"Pileo coriaceo-suberoso applanato elongato sessili nudo e basi ad marginem acutum sinuosum rugoso-radiato concentrice sulcato, postice nigricante, antice fulvo, poris minutis rotundis ore obtusis fuscescentibus, intus contextuque fulvis."

This description may have been made from an old discolored specimen.

13. **Cubamyces** gen. nov.

Type: *Polyporus cubensis* Mont.

Hymenophore large, annual, epixylous, sessile, thin, dry, conchate; surface pelliculose, glabrous, normally azonate; context white or yellowish, thin, homogeneous, very soft and elastic; hymenium concolorous, tubes small and regular, rather thick-walled, firm and corky, mouths entire; spores smooth, hyaline.

Cubamyces cubensis (Mont.)

Polyporus cubensis Mont. Ann. Sci. Nat. II. Bot. **8**: 364. 1837; Pl. Cell. Cuba 404. *pl. 16. f. 3.* 1842.

Originally described from plants collected near Havana, Cuba, by Sagra. It seems especially abundant in Cuba, but occurs also in southern Florida and Central America.

Cuba, *Underwood & Earle 543, 544, 596, 1111, 1204, 1443, 1568*, *Earle & Murrill 140, 337, 534, 414*; Florida, *Lloyd*; Nicaragua, *Smith*.

SPECIES INQUIRENDAE

POLYPORUS HAVANNENSIS B. & C. Jour. Linn. Soc. Bot. **10**: 310. 1868. Described from specimens collected by Wright on dead wood in Cuba as follows:

"Pileo dimidiato convexo zonato fulvo-ochraceo e pubescente glabro radiato-ruguloso, margine leviter pulvinato sterili pubescente; hymenio pallido, poris parvis subrotundis acie obtusis. Pileus 2 inches wide, 1 inch long; pores $\frac{1}{100}$ inch in diameter. Allied to *P. anebus*, B[erk]., but with larger pores."

This species appears to be very near to *C. cubensis*.

14. PORONIDULUS Murr. Bull. Torrey Club **31**: 425. 1904

Type: *Boletus conchifer* Schw.

Hymenophore annual, tough, sessile, epixylous, at first sterile and cup-like, the fertile portion developing from the sterile; context white, fibrous, tubes short, thin-walled, mouths polygonal; spores ellipsoidal, smooth, hyaline.

Species: *P. conchifer* (Schw.) Murr. [See Bull. Torrey Club **31**: 425, 426. 1904.]

15. CORIOLUS Quél. Ench. Fung. 175. 1886.

Type: *Polyporus zonatus* Fr.

Hansenia Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. (Not *Hansenia* Turcz. 1844.) Type: *Boletus hirsutus* Wulf.

Hymenophore annual, epixylous, sessile, zonate, anoderm, hairy or glabrous; context thin, white, flexible, fibrous, leathery; tubes thin-walled, white, at length splitting into irpiciform teeth in several species, mouths polygonal or irregular; spores smooth, hyaline.

The species of this genus will be treated in a later number of this series.

16. **Coriolellus** gen. nov.

Type: *Trametes Sepium* Berk.

Hymenophore small, dry, annual, epixylous, semi-resupinate; surface white, anoderm, usually azonate; context white, thin, fibrous to corky; hymenium concolorous, tubes thin-walled, usually large and irregular, dentate, but not irpiciform; spores smooth, hyaline.

Coriolellus Sepium (Berk.)

Trametes Sepium Berk. Lond. Jour. Bot. **6**: 322. 1847.

Described from specimens collected by Lea on dry fence-rails in Ohio as follows:

"Pilei effused at the base, reflexed above, laterally connate, at first often attached by the vertex or triquetrous, pale wood-coloured, finely tomentose, marked with numerous darker zones. Hymenium pallid, consisting of slightly sinuous pores about $\frac{1}{30}$th of an inch in diameter."

This species occurs on various kinds of structural timber and other dead wood, especially of deciduous trees, throughout most of temperate North America. Oak and chestnut posts and poles with the bark removed frequently supply the sporophores in great numbers. Only a few collections are here mentioned:

Canada, *Macoun;* Connecticut, *Hanmer;* New York, *Underwood*, *Mrs. Livingston* and *Miss Crane;* New Jersey, *Ellis;* Virginia, *Murrill;* South Carolina, *Ravenel;* Tennessee, *Murrill;* Ohio, *Lloyd;* Kansas, *Cragin.*

17. GRIFOLA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 643. 1821

Type: *Boletus frondosus* Dicks.

Polypilus Karst. Rev. Myc. $\mathbf{3}^{9}$: 17. 1881. Type: *Boletus frondosus* Schrank.

Meripilus Karst. Bidr. Findlands Nat. och Folk **37**: 33. 1882. Type: *Boletus giganteus* Pers.

Cladomeris Quél. Ench. Fung. 167. 1886. Type: *Polyporus umbellatus* Fr.

Hymenophore large, annual, stipitate, compound, intricately branched or lobed, humus-loving or epixylous, rarely terrestrial, usually found at the base of a tree-trunk; surface smooth, pallid to gray or brown; context white, fleshy or fleshy-tough, rigid and fragile when dry; tubes large, irregular, thin-walled, becoming friable or laciniate with age; spores hyaline, smooth, rarely verrucose.

Species: *G. poripes* (Fr.) Murr., *G. Sumstinei* Murr., *G. frondosa* (Dicks.) S. F. Gray, *G. ramosissima* (Scop.) Murr., *G. Berkeleyi* (Fr.) Murr., *G. fractipes* (B. & C.) Murr. [See Bull. Torrey Club **31**: 333–338. 1904].

18. SCUTIGER Paul. Icon. Champ. *pl. 31. f. 1–3.* 1793

Type: *Scutiger tuberosus* Paul.

Albatrellus S. F. Gray Nat. Arr. Brit. Pl. **1**: 645. 1821. Type: *Boletus albidus* Pers.

Caloporus Quél. Ench. Fung. 164. 1886. Type: *Boletus subsquamosus* L.

Hymenophore simple, terrestrial annual, mesopous, usually bright-colored: surface anoderm, variously decorated; context white, rarely colored, fleshy to tough, rigid and fragile when dry; hymenium porose, white or colored, tubes thin-walled; spores smooth, hyaline.

Species: *S. Ellisii* (Berk.) Murr., *S. retipes* (Underw.) Murr., *S. decurrens* (Underw.) Murr., *S. cryptopus* (Ell. & Barth.) Murr., *S. laeticolor* Murr., *S. caeruleoporus* (Peck) Murr., *S. holocyaneus* (Atk.) Murr., *S. radicatus* (Schw.) Murr., *S. subradicatus* Murr., *S. griseus* (Peck) Murr., *S. persicinus* (B. & C.) Murr., *S. Whiteae* Murr. [See Bull. Torrey Club **30**: 425–432. 1903].

19. PORODISCUS Murr. Bull. Torrey Club **30**: 432. 1903

Type: *Peziza pendula* Schw.

Enslinia Fr. Summ. Veg. Scand. 399. 1849. (Not *Enslinia* Rchb. 1827.) Type: *Sphaeria pocula* Schw.

Hymenophore small, annual, tough, epixylous, erumpent from the lenticels of dead branches; stipe attached to the vertex of the pileus, usually curved at maturity; context white, fibrous, tubes cylindrical, short, one-layered, mouths constricted; spores globose, smooth, hyaline.

Species: *P. pendulus* (Schw.) Murr. [See Bull. Torrey Club **30**: 432–434. 1903].

20. ABORTIPORUS Murr. Bull. Torrey Club **31**: 421. 1904

Type: *Boletus distortus* Schw.

Hymenophore annual, tough, humus-loving; stipe normally central, often obsolete; context yellowish-white, duplex, spongy above, woody below, tubes thin-walled, mouths polygonal; spores subglobose, smooth, hyaline.

Species: *A. distortus* (Schw.) Murr. [See Bull. Torrey Club **31**: 421, 422. 1904].

21. **Microporellus** gen. nov.

Type: *Polyporus dealbatus* B. & C.

Hymenophore thin, annual, epixylous, usually flabelliform, stipitate, the stipe variously attached and sometimes much reduced; surface anoderm, multizonate; context thin, white, fibrous, rigid and fragile when dry; tubes very minute, regular, thin-walled, fragile when dry; spores smooth, hyaline.

Synopsis of the North American species

Plants white or pale brownish, the color not changing when dry. *M. dealbatus.*
Plants lurid, becoming black when dry. *M. holotephrus.*

Microporellus dealbatus (B. & C.)

Polyporus dealbatus B. & C. Ann. Mag. Nat. Hist. II. **12**: 432. 1853.

Polyporus mutabilis B. & C. Ann. Mag. Nat. Hist. II. **12**: 433. 1853.

Polyporus petaliformis B. & C. Jour. Linn. Soc. Bot. **10**: 307. 1868.

Polyporus polygrammus B. &. C. Jour. Linn. Soc. Bot. **10**: 307. 1868.

Polyporus Ravenelii B. & C. Grevillea **1**: 38. 1872. *Polystictus cretatus* Cooke, Trans. Bot. Soc. Edinburgh **13**: 137. 1878.

This remarkably variable plant was originally described from the collections of Curtis in South Carolina, and has since been published by the same authors under several different names. The types at Kew show abundant variations, but no good characters for specific separation. The species ranges southward to the West Indies and into South America, where it has doubtless received other names.

Collections are at hand from South Carolina, *Ravenel;* Georgia, *Ricker;* Florida, *Ravenel;* Louisiana, *Langlois;* Alabama, *Peters,* *Beaumont, Earle;* Cuba, *Earle, Underwood & Earle 758, 793, 1104a, 1316, 1319, 1446.*

Microporellus holotephrus (B. & C.)

Polyporus holotephrus B. & C. Jour. Linn. Soc. Bot. **10**: 315. 1868.

Described as follows from *no. 352* of Wright's Cuban collections, although Guiana (*Leprieur 929*) is mentioned as the habitat.

"Luridus; pileo tenui coriaceo flabelliformi, e basi attenuata lineato, hic illic vinoso-tincto zonato, zonis alternis subtiliter velutinis scabris brunneis; poris 5–6-gonis brevibus minimis.

"On dead wood. Pileus $2\frac{1}{2}$ inches broad, 2 inches long, radiato-lineate; pores $\frac{1}{200}$ inch in diameter. A very curious species."

This peculiar plant, known only from the original collections, now at Kew, bears a very close resemblance to *M. dealbatus* in every respect except color. One could almost believe that a few very young plants of *M. dealbatus* had for some cause turned entirely black in drying, if the numerous other collections of this species indicated the slightest tendency in that direction. Another difference is the size of pores, those of *M. holotephrus* being entirely inconspicuous to the unaided eye.

22. POLYPORUS (Mich.) Paul. Icon. Champ. *pl. 13.* 1793.

Type: *Polyporus Ulmi* Paul.

Polyporus (Mich.) Adans. Fam. **2**: 10. 1763. Not associable with a previously published binomial.

Polyporellus Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 37. 1879. Type: *Polyporus brumalis* Fr.

Leucoporus Quél. Ench. Fung. 165. 1886. Type: *Leucoporus tubarius* Quél.

Cerioporus Quél. Ench. Fung. 167. 1886. Type: *Boletus squamosus* Huds.

Melanopus Pat. Hymén. Europ. 137. 1887. Type: *Melanopus squamosus* (Huds.) Pat.

Hymenophore annual, epixylous, small and simple, very rarely large and compound; stipe central, excentric or lateral, much reduced at times in a few species, often partly or wholly brown or black; surface usually smooth, the margin at times ciliate; context white or yellowish, fibrous, tough to corky; hymenium porose, rarely alveolate; spores smooth, hyaline.

Species: *P. hydniceps* B. & C., *P. scabriceps* B. & C., *P. virgatus* B. & C., *P. delicatus* B. & C., *P. dibaphus* B. & C., *P. polyporus* (Retz) Murr., *P. Tuba* B. & C., *P. craterellus* B. & C., *P. Acicula* B. & C., *P. discoideus* B. & C., *P. phaeoxanthus* B. & Mont., *P. columbiensis* Berk., *P. obolus* Ell. & Macbr., *P. aemulans* B. & C., *P. arculariellus* Murr., *P. arcularius* (Batsch) Fr., *P. variiporus* Murr., *P. Tricholoma* Mont., *P. Cowellii* Murr., *P. caudicinus* (Scop.) Murr., *P. maculosus* Murr., *P. elegans* (Bull.) Fr., *P. fissus* Berk., *P. arculariformis* Murr. [See Bull. Torrey Club **31**: 29–44, 1904; and Torreya **4**: 150, 151. 1904.]

Synopsis of the Polyporeae with bright-colored context

Hymenophore sessile or subsessile.	
Pores yellow.	
Context thick and fleshy, plants very large.	1. *Laetiporus.*
Context thin; plants small.	2. *Flaviporellus.*
Pores red.	
Context very soft and spongy, tubes large and irregular.	3. *Aurantiporellus.*
Context firm, tubes small.	
Surface anoderm, tubes fragile.	
Tubes orange-colored, becoming dark and resinous on drying.	4. *Aurantiporus.*
Tubes remaining orange-colored, or fading slightly.	5. *Pycnoporellus.*
Surface pelliculose, tubes firm and regular.	6. *Pycnoporus.*
Hymenophore distinctly stipitate; context yellow.	7. *Phaeolopsis.*

1. LAETIPORUS Murr. Bull. Torrey Club **31**: 607. 1904

Type: *Agaricus speciosus* Batarr.

Hymenophore annual, epixylous, fleshy, anoderm, cespitose-multiplex; context cheesy to fragile, light-colored, tubes thin-walled, fragile, bright-yellow, mouths irregularly polygonal; spores smooth, hyaline.

Species: *L. speciosus* (Batarr.) Murr. [See Bull. Torrey Club **31**: 607, 608. 1904.]

2. **Flaviporellus** gen. nov.

Type: *Polyporus Splitgerberi* Mont.

Hymenophore small, annual, epixylous, sessile or substipitate, flabelliform, yellow throughout; surface anoderm, margin thin; context very thin and friable; tubes small, thin-walled, fragile; spores smooth, hyaline or yellowish.

Flaviporellus Splitgerberi (Mont.)

Polyporus Splitgerberi Mont. Ann. Sci. Nat. Bot. II. **16**: 109. 1841. Syll. Crypt. 164. 1856.

Polyporus sulphuratus Fr. Nov. Symb. 79. 1851.

Polyporus rheicolor B. & C. Jour. Linn. Soc. Bot. **10**: 313. 1868.

This plant was described from Surinam, Mexico and Cuba successively. It is apparently rare, being known chiefly from type collections at Kew, Paris and Upsala.

3. **Aurantiporellus** gen. nov.

Type: *Polyporus alboluteus* Ell. & Ev.

Hymenophore large, annual, epixylous, effused, immarginate or narrowly reflexed; surface azonate, soft, anoderm and orange-colored when young, becoming slightly encrusted and darker with age; context orange-colored, extremely soft and spongy throughout; tubes orange-colored, very large, thin-walled, irregular, lacerate, fragile; spores smooth, hyaline.

Aurantiporellus alboluteus (Ell. & Ev.)

Fomes alboluteus Ell. & Ev. Proc. Acad. Sci. Phila. **1895**: 413. 1895.

Described from material collected by Crandall on decayed trunks of *Abies subalpina* in Colorado as follows:

"Effused and laterally connate for several centimeters, about 1 cm. thick and 5–6 cm. broad, immarginate and entirely resupinate or, in some specc. with a very slight, reflexed margin of soft, spongy texture and light orange color within and without. Pores large, 1–2 mm. diam., with a thin, membranaceous, white, toothed margin."

In 1898 (Bull. Torrey Club **25**: 513), the authors add the following notes:

"Additional specimens and notes of this species show that it is a *Polyporus* and not a *Fomes*. In the fresh growing state it is very juicy and absorbs moisture to a remarkable degree so that water may be squeezed out of it as from a sponge. Some specimens were 3–4 cm. thick. When mature the pores are prolonged on one side so as to resemble the teeth of an *Irpex*. The spores are oblong, hyaline, 8–12 × 3 μ. Allied to *Polyporus leucospongia* Cke. & Hark."

This species has apparently been found by only two botanists. The type plants were collected July 10, 1894, by C. S. Crandall, *no. 50*, upon charred trunks of *Abies* on the crest of the continental divide, Colorado, at an altitude of 3,000 meters. Specimens were later collected by Bethel, *no. 280*, at Climax, Colorado, at a height of 3,390 meters, on the ends of decaying coniferous logs projecting from the snow.

4. **Aurantiporus** gen. nov.

Type: *Polyporus Pilotae* Schw.

Hymenophore large, annual, epixylous, sessile, dimidiate; surface anoderm, sodden, bibulous, reddish-orange, soon fading; context reddish-yellow, fleshy-tough to woody, juicy when fresh, rigid when dry, conspicuously zonate; tubes small, slender, thin-walled, brilliant orange when fresh, becoming dark, resinous and fragile on drying; spores smooth, hyaline.

Aurantiporus Pilotae (Schw.)

Polyporus Pilotae Schw. Trans. Am. Phil. Soc. **4**: 156. 1834.
Polyporus Pini-canadensis Schw. Trans. Am. Phil. Soc. **4**: 157. 1834.
Polyporus hypococcinus Berk. Lond. Jour. Bot. **6**: 319. 1847.

This brilliantly colored species was first described from specimens collected on Pilot mountain, North Carolina, growing on a chestnut log. According to Morgan these specimens had lost their brilliancy when Schweinitz found them, which partly accounts for Berkeley's redescription of the species under the name of *P. hypococcinus* when Lea's younger plants were sent him from Ohio. Original specimens examined at Kew and at Philadelphia are excellently preserved and show the two species to be synonymous. No specimens are to be found, however, of *P. Pini-canadensis*, which Berkeley & Curtis in their commentary on Schweinitz's Synopsis say is certainly the same as *P. hypococcinus*. This species was described from plants found in a pine swamp near Mauch Chunk, Pennsylvania, growing on a trunk of *Pinus canadensis*, according to Schweinitz. It is possible that he was mistaken in the host. Specimens collected by Nuttall on dead deciduous logs in West Virginia are also resupinate and agree well with the description of *P. Pini-canadensis*. *P. Pilotae* and *P. hypococcinus* are only known to occur on very much decayed wood of oak and chestnut.

This species is quite rare, but those who have found it have made good notes on its appearance when fresh; attracted, no doubt, by its striking appearance. As I have observed it growing on old logs at Blacksburg, Virginia, the sporophores are ochraceous to reddish-orange at first, the pileus becoming paler and the hymenium darker with age. The substance within is honey-yellow, changing to reddish, and very zonate. On account of the rather fleshy and sodden character of the sporophore there is considerable shrinkage and change of form on drying. Specimens have been examined from Canada, *Dearness*; Iowa, *Macbride*; Delaware, *Commons* (?); Pennsylvania, *Sumstine, Murrill*; West Virginia, *Nuttall*; Virginia, *Murrill*; Ohio, *Morgan.*

SPECIES INQUIRENDAE

POLYPORUS FIMBRIPORUS Schw. Trans. Am. Phil. Soc. **4**: 155. 1834. Collected on small fallen chestnut limbs at Bethlehem, Pennsylvania, and described as follows:

"P. subtriangularis, substantia carnosa, aquose spongiosa, omnino *P. mollis.* Pileo glabro, pallido, siccitate ruguloso et contracto volumine. Poris albescentibus, rotundis, minutis, circum apices mire fimbriato ciliatis. Diametro unciali. Tempore sicco indurescit."

The above description agrees in many ways with young stages of *A. Pilotae*, but this latter species has never been collected on small limbs, its usual hosts being much-decayed chestnut or oak logs. The remains of the type specimens at Philadelphia also show a close relationship to *A. Pilotae.*

POLYPORUS CASTANOPHILUS Atk. Jour. Myc. **8**: 118. 1902. Collected by Atkinson at Blowing Rock, North Carolina, September 1901 (*no. 10072* Cornell Univ. Herb.), and thus described:

"Pileus dimidiate, sessile, convex, 10–20 cm. broad, 10–12 cm. long, zonate, more or less rugose and sometimes tomentose toward the base, reddish yellow to reddish orange, flesh yellowish, zoned, soft and watery but tough and drying somewhat shrunken but hard and firm. Tubes plane, medium size, dissepiments thin, edges very finely fimbriate, chrome yellow to bright orange, drying dull yellow or reddish brown, tubes 6–8 mm. long. Basidia clavate, $15–20 \times 4–5\ \mu$, 4-spored. Spores white, hyaline, smooth, with a few granules, $3 \times 2\ \mu$. On decorticated and one-half rotted chestnut logs."

Although I have not been able to examine the plants described above, there seems to be little doubt that they are referable to *A. Pilotae*.

5. **Pycnoporellus** gen. nov.

Type: *Polyporus fibrillosus* Karst.

Hymenophore annual, epixylous, sessile, dimidiate, simple or imbricate, reddish or orange-colored throughout; surface anoderm, margin thin; context thin, friable; tubes thin-walled, fragile, at length lacerate; spores smooth, hyaline or pale yellowish.

Pycnoporellus fibrillosus (Karst.).

Polyporus fibrillosus Karst. Sydv. Finl. Polyp. 30. 1859.

Polyporus aurantiacus Peck, Rep. N. Y. State Mus. Nat. Hist. **26**: 69. 1874.

Inonotus fibrillosus Karst. Bidr. Finl. Nat. och Folk **37**: 72. 1882.

In 1876 Karsten considered this species synonymous with *Polyporus vulpinus* Fr., but later said the two were very different. According to Bresadola, *Ochroporus lithuanicus* Blonski (Hedwigia 281. 1889) is a true synonym of *P. fibrillosus*.

This species is rarely found in Asia, Europe and northern North America on decaying logs of fir, spruce and other conifers. Its bright colors make its discovery easy, while the fragile tubes and rigid, friable context distinguish it readily from *Pycnoporus cinnabarinus*.

Finland, *Karsten*; Canada, *Macoun*; New York, *Peck*; Vermont, *Burt*; Colorado, *Bethel*; Oregon, *Carpenter*.

6. PYCNOPORUS Karst. Rev. Myc. $\mathbf{3}^{9}$: 18. 1881

Type: *Boletus cinnabarinus* Jacq.

Hymenophore annual, sometimes reviving, epixylous, sessile, dimidiate, simple or imbricate, rarely pseudo-stipitate; surface anoderm, slightly pelliculose at times, zonate or azonate, bright or dull red; context red, soft-corky to punky; hymenium concolorous, tubes small, firm, thin-walled; spores smooth, hyaline.

Species: *P. cinnabarinus* (Jacq.) Karst., *P. sanguineus* (L.) Murr. [See Bull. Torrey Club **31**: 420, 421. 1904.]

7. **Phaeolopsis** gen. nov.

Type: *Polyporus Verae-crucis* Berk.

Hymenophore annual, expixylous, stipitate; surface azonate, anoderm, yellow or brown; margin acute; context yellow, fleshy to tough and fibrous, not friable; tubes yellow, regular, minute, thin-walled; spores smooth, hyaline: stipe excentric or lateral with substance and surface like that of the pileus.

Phaeolopsis Verae-crucis (Berk.)

Polyporus Verae-crucis Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 369. *pl. 9–12.* 1843.

Described from plants collected on the roots of trees at Vera Cruz, August, 1854. Type plants at Kew are in an excellent state of preservation. The context of these herbarium specimens is dark yellowish-orange and the stipe excentric or lateral.

SUBFAMILY 2. FOMITEAE

Synopsis of the Fomiteae with white or flesh-colored context

Tubes at first concealed by a volva. 1. *Cryptoporus.*
Tubes free from the first.
  Surface of hymenophore covered with reddish-brown varnish; context corky. 2. *Ganoderma.*
  Surface of hymenophore not as above, or, if so, context woody. 3. *Fomes.*

1. CRYPTOPORUS Shear, Bull. Torrey Club **29**: 450. 1902

Type: *Polyporus volvatus* Peck.

Hymenophore subglobose, sessile, epixylous; surface smooth, encrusted; context white, corky; tubes white, concealed at first by a volva, which breaks at one or more points at maturity; mouths constricted, discolored; spores smooth, hyaline.

Species: *C. volvatus* (Peck) Shear. [See Bull. Torrey Club **30**: 423, 424. 1903.]

2. GANODERMA Karst. Rev. Myc. 3^{9}: 17. 1881

Type: *Boletus lucidus* Leyss.

Placodes Quél. Ench. Fung. 170. 1886. Type: *Boletus lucidus* Leyss.

G. Tsugae Murr. and a few other species of this genus might be classed with white-fleshed forms, especially in their early stages. [See Bull. Torrey Club **29**: 599–608. 1902].

3. FOMES Gill. Champ. Fr. **1**: 682. 1878

Type: *Polyporus marginatus* Fr.

Fomitopsis Karst. Rev. Myc. 3^{9}: 18. 1881 Type: *Boletus pinicola* Sw.

Heterobasidion Bref. Unters. **8**: 154. 1889. (Not *Heterobasidium* Mass. 1888.) Type: *Polyporus annosus* Fr.

Hymenophore sessile, ungulate or applanate, epixylous; surface anoderm or encrusted, sulcate, rarely zonate; context white or flesh-colored, woody, rarely punky; tubes cylindrical, concolorous, usually thick-walled, stratose; pores smooth, hyaline.

Species: *F. roseus* (Alb. & Schw.) Cooke, *F. annosus* (Fr.) Cooke, *F. ungulatus* (Schaeff.) Sacc., *F. Ellisianus* Anders., *F. fraxinophilus* (Peck) Sacc., *F. ligneus* (Berk.) Cooke, *F. stipitatus* Murr., *F. perpusillus* (Pers.) Cooke, *F. scutellatus* (Schw.) Cooke, *F. Laricis* (Jacq.) Murr., *F. populinus* (Schum.) Cooke, *F. Meliae* (Underw.) Murr., *F. rubritinctus* Murr., *F. geotropus* Cooke. [See Bull. Torrey Club **30**: 225–232. 1903.]

An original specimen of Persoon's *Polyporus perpusillus*, published by Léveillé in 1844, shows this plant to be the same as *Trametes ohiensis* Berk., published in 1872. Persoon's name, therefore, must be adopted instead of the one under which the species is commonly known. Considering the very small size of the species, the older name seems exceedingly appropriate.

To the above list of species should be added **Fomes Auberianus** (*Polyporus Auberianus* Mont. Pl. Cell. Cuba 397. 1842), described from Cuban plants collected by Auber. It is a large and striking species found on wounded trunks or dead logs of hardwood trees throughout tropical America. Material is at hand from Cuba, *Earle*, *Earle & Wilson 253*, *Earle & Murrill 4*; Porto Rico, *Wilson 32*; St. Kitts, *Britton & Cowell 328*; Martinique, *Duss*; Mexico, *Smith*.

SUBFAMILY 3. AGARICEAE

Synopsis of the Agariceae with white context

Surface glabrous, hymenium usually labyrinthiform. 1. *Agaricus*.
Surface pubescent or hirsute.
  Hymenium at first labyrinthiform, soon becoming irpiciform. 2. *Cerrena*.
  Hymenium lamellate, not becoming irpiciform. 3. *Lenzites*.

1. AGARICUS (Dill.) L. Sp. Pl. 1176. 1753

Type: *Agaricus quercinus* L.

Striglia Adans. Fam. **2**: 10. 1763. Type: *Agaricus quercinus* L.
Daedalea Pers. Syn. Fung. 499. 1801. Type: *Agaricus quercinus* L.

Daedaleopsis Schroet. Krypt. Fl. Schles. **3**: 492. 1888. Type: *Boletus confragosus* Bolt.

Hymenophore epixylous, usually large and annual, sessile, applanate to ungulate; surface anoderm, glabrous, often zonate: context white or wood-colored, rigid, woody or punky: hymenium normally labyrinthiform, but varying to lamellate and porose in some species: spores smooth, hyaline.

Species: *A. quercinus* L., *A. juniperinus* Murr., *A. confragosus* (Bolt.) Murr., *A. Aesculi* (Schw.) Murr., *A. deplanatus* (Fr.) Murr. [See Bull. Torrey Club **32**: 83–95. 1905.]

2. CERRENA S. F. Gray Nat. Arr. Brit. Pl. **1**: 649. 1821

Type: *Boletus unicolor* (Bull.) Bolt.

Phyllodontia Karst. Hedwigia **22**: 163. 1883. Type: *Phyllodontia Magnusii* Karst.

Hymenophore small, epixylous, sessile, conchate, annual; surface anoderm, hairy, zonate or sulcate; context thin, white, fibrous, flexible; hymenium at first labyrinthiform, soon becoming irpiciform from the splitting of the dessepiments; spores smooth, hyaline.

Species: *C. unicolor* (Bull.) Murr. [See Bull. Torrey Club **32**: 97–99. 1905.]

3. LENZITES Fr. Gen. Hymen. 10. 1836

Type: *Daedalea betulina* (L.) Fr.

Hymenophore small, annual, epixylous, sessile, conchate: surface anoderm, usually zonate and tomentose; context white, coriaceous, flexible; hymenium lamellate, the radiating gill-like dissepiments connected transversely at times, especially in youth; spores smooth, hyaline.

Species: *L. betulina* (L.) Fr., *L. cubensis* B. & C. [See Bull. Torrey Club **32**: 95–97. 1905.]

NEW YORK BOTANICAL GARDEN.

Index to genera

Onosmodium

Kenneth Kent Mackenzie

The genus *Onosmodium*, founded in 1803 by Michaux, is a genus of *Boraginaceae* exclusively confined to North America and very largely to that portion of the United States east of the Rocky Mountains. The species are closely related and their proper identification has given much trouble to collectors, as evidenced by the large number of incorrectly labeled specimens found in herbaria. Many of the characters given in the standard manuals are not constant, and are misleading unless used with considerable discrimination ; this probably accounts for the great number of errors in herbarium determinations. The following notes are based on an examination of the specimens contained in the herbaria of the Missouri Botanical Garden, the New York Botanical Garden, and Columbia University, and in the author's private herbarium.

Properly limited, the genus is a very natural one and may be characterized as follows:

Erect, rough-hairy, branching, very leafy perennials, with alternate, entire, strongly veined leaves, and numerous flowers in terminal, leafy-bracted, scorpioid racemes. Flowers whitish, greenish-white or yellowish, from sessile to short-pedicelled, the pedicels usually somewhat elongating in fruit. Calyx shorter than the corolla, deeply 5-parted. Corolla tubular, slightly enlarged at the throat, 5-lobed, glabrous within, more or less hairy outside, the lobes erect, acute or acuminate, the sinuses somewhat inflexed. Stamens five, inserted on the corolla, included ; filaments minute ; anthers glabrous, narrowly arrow-shaped, acutish, the apex just about level with the sinuses of the corolla. Ovary four-parted. Style filiform, exserted, long persistent. Nutlets 4 mm. long or less, usually but one or two maturing, globular to ovoid, smooth or sometimes sparingly pitted, white to dingy whitish-brown, in some species noticeably constricted below, attached at base to the nearly flat receptacle, the scar of attachment about 2 mm. wide. (Greek, "like *Onosma*," an old-world genus of *Boraginaceae.*) Seven species, confined to the United States and Canada.

It will be noticed that under this characterization the plant called *Onosmodium Thurberi* by A. Gray (Syn. Fl. **2**^{1} : 205. 1878) does not fall within this genus. That species, however, is so self-evidently not congeneric with real *Onosmodium* that I feel no hesitation in removing it therefrom. It differs from *Onosmodium* in the greatly elongated corolla, exserted stamens, long filaments and versatile anthers, in usually ripening more nutlets, and in the persistence of the enlarged base of the style. For the present I refer it to *Macromeria* as **Macromeria Thurberi.** It seems certainly congeneric with *M. viridiflora* DC., *M. cinerascens* DC., and *M. discolor* Benth. Whether these species are congeneric with the original species of Don I cannot determine at present, the material I have seen being too scanty.

Onosmodium strigosum G. Don, Gen. Syst. **4**: 317 (1838), and *Onosmodium eriocaulon* A. DC. in DC. Prodr. **10** : 70 (1846), both from Northern Mexico, may be the same. The former as represented in herbaria is not an *Onosmodium*, the corolla and anthers both being very different. Of the latter I have seen no specimens.

The species of true *Onosmodium* which I have been able to recognize may be distinguished as follows :

Bracts ovate, rounded at base ; fruiting pedicels usually exceeding the sepals ; corolla 5–7 mm. long. 1. *O. Helleri.*

Bracts narrower, tapering at base ; fruiting pedicels rarely as long as the sepals ; corolla 9 mm. long or longer.

- Corolla-lobes narrowly lanceolate-acuminate, two to three times as long as wide.
  - Pubescence appressed. 2. *O. virginianum.*
  - Pubescence spreading. *O. virginianum hirsutum.*
- Corolla-lobes broadly triangular-acute, little longer than wide.
  - Stem not glabrous below the branches.
    - Nutlets noticeably pitted ; calyx-lobes 6 mm. long or less, noticeably soft-pubescent. 3. *O. molle.*
    - Nutlets little if at all pitted ; calyx-lobes hispid.
      - Corolla-lobes merely acute.
        - Nutlets strongly constricted at base.
          - Nutlets less than 3 mm. long. 4. *O. hispidissimum.*
          - Nutlets about 4 mm. long. *O. hispidissimum macrospermum.*
        - Nutlets not strongly constricted at base.
          - Nutlets 4 mm. long (rarely a little less). 5. *O. occidentale.*
          - Nutlets 3 mm. long (rarely 3.5 mm. long). *O. occidentale sylvestre.*

Corolla-lobes acuminate, often strongly so.
6. *O. bejariense.*
Stem glabrous below the branches. 7. *O. subsetosum.*

1. ONOSMODIUM HELLERI Small

Onosmodium Helleri Small, Fl. Southeast. U. S. 1000. 1903.

Perennial, 3–4 dm. high, short-pubescent all over with scattered hairs or densely soft-pubescent on the leaves beneath: leaves obtusish, short-petioled, 8–10 cm. long, 3–5 cm. wide, the lower broadly spatulate and tapering to the base, the middle broadly oblong-elliptical and rounded at base; bracts broadly ovate (at least the lower): fruiting pedicels 7–15 mm. long, usually exceeding the sepals: calyx-lobes 7–10 mm. long, linear, obtusish, ciliate: corolla not seen: nutlets obtusish, 3 mm. long, ovate-orbicular, apparently not constricted at base.

Type collected by A. A. Heller, April 30, 1894, along Bear Creek, Kerr County, Texas, *no. 1682.* A flowering specimen with corollas 5–7 mm. long and acute-triangular teeth pubescent outside, and generally resembling this species, is provisionally referred here, for the reason that the leaves are all merely oblanceolate or spatulate, but the specimen is young and the leaves are probably not fully developed.

This species is easily distinguished from all others by the characters given in the key and, in addition, by the short-petioled leaves. It seems to be confined to southwestern Texas, and has been rarely collected.

SPECIMENS EXAMINED. TEXAS: type specimen as cited above; *W. L. Bray 26*, 25 March 1898, Mt. Barker, Austin (the flowering specimen cited above); *Lindheimer*, 1850, "Texas"; *Reverchon 156*, June 1884, Bandera Pass.

2. ONOSMODIUM VIRGINIANUM (L.) DC.

Lithospermum virginianum L. Sp. Pl. 132. 1753.
Onosmodium hispidum Michx. Fl. Bor. Am. **1**: 133. 1803.
Onosmodium virginianum A. DC. Prodr. **10**: 70. 1846.
? *Onosmodium scabrum* R. & S. Syst. **4**: 57. 1819.

An erect perennial, 3–4.5 dm. high, or sometimes more, branching above with spreading branches; stems and branches usually shortly appressed-strigose: leaves from oblong-elliptical to narrowly spatulate, typically 5.4 cm. long and 1.4 cm. wide, usually rather strongly obtuse, but occasionally quite acute, 3–5 nerved, shortly appressed-strigose on both sides, the pubescence above sometimes quite papillose, but never as strongly developed as in the other species: bracts oblanceolate: fruiting pedicels 6 mm. long or less: calyx-lobes lanceolate-acuminate, 6–8 mm. long, hairy with spreading pubescence: corolla 9 mm. long (less than twice the length of the calyx), glabrous, light-yellowish, the lobes 3 mm. long, narrowly lanceolate-acuminate bearing apical tufts of hairs: nutlets 2.5 mm. long or less, obtusish or acutish, little if at all constricted at base.

All other species of *Onosmodium* have dirty-white corollas often distinctly tinged with green, but *O. virginianum* has distinctly yellow corollas, a character which added to the peculiar corolla-lobes readily distinguishes it from all others.

The standard manuals of the country give this species a range over the entire United States east of Kansas, but I have been able to find no specimens collected very far from the Atlantic or Gulf coasts, and am convinced that the specimens collected in the interior of the United States and referred to this species have been wrongly determined. This conclusion is borne out by the fact that in the collections examined by me are numerous specimens from the interior erroneously referred to this species, and it is on these specimens I believe that the extended range is based. As far as I can determine, the species, with its variety mentioned below, ranges along the Atlantic coast from Connecticut to Florida and thence west along the Gulf coast to Louisiana.

SPECIMENS EXAMINED. CONNECTICUT: *Bissell*, 6 August 1901, Oxford. NEW JERSEY: *Parker*, 2 June 1865, Burlington County; *Pollard*, 25 September 1897, Clementon. PENNSYLVANIA: *Britton*, 4 July 1899, Point Pleasant. VIRGINIA: *Addison Brown et al.*, 7 June 1890, Peaks of Otter; *Small & Heller*, 3 June 1891, Danville. NORTH CAROLINA: *Biltmore Herbarium 4253*, 17 June 1897, Hamlet, Richmond County. SOUTH CAROLINA: *Gibbes*, May 1834, Columbia; *Gibbes*, 1886, Andersonville. GEORGIA: *Beyrich 266*; *Cuthbert*, 3 May 1900, Augusta; *Small*, 9–12 July 1895, Albany, Dougherty County; *Small*, 20 July 1893 and 2 July 1895, McGuire's Mill, Gwinnet County. FLORIDA: *Curtiss 6611*, 9 May 1900, Seville, Volusia County; *Curtiss 2098*, April-May, Duval County; *Curtiss 4379*, 11 April 1893, Jacksonville; *Curtiss 4723*, 28 April 1894, Jacksonville; *Lighthipe 633*, April

1897; *Phillips*, Duval County; *Nash*, March 12–31 and May 4 1894, also 28 May 1895, Eustis, Lake County; *Hitchcock*, June and July 1898, Lake City; *Hitchcock*, June and July 1894, Eustis; *Rugel*, July 1843, Aspalaga; *Ohlinger*, 12 April 1894, Polk County; *Ferguson*, 8 August 1898, Tampa; *Huger*, April 1900, "Fla."; *Barrows* (1834), *Cozzens*, *Chapman*, and *Buckley*, "Fla." ALABAMA: *Earle & Baker*, 29 May 1897, Auburn, Lee County. LOUISIANA: *Hale*, Alexandria.

Onosmodium virginianum hirsutum var. nov.

Pubescence spreading; often strongly so.

This form differs from typical *O. virginianum* in the one character only, but on this account has sometimes been confused with other species. It seems to be confined to the southeastern United States; I have seen specimens from Alabama, Georgia, Florida and Mississippi.

SPECIMENS EXAMINED. GEORGIA: *Allmendinger*, Kennesaw Mt. ALABAMA: *Earle & Baker*, 29 May 1897, Auburn, Lee County (type specimen). FLORIDA: *Chapman; Curtiss 2098*, May, Jacksonville. MISSISSIPPI: *Hilgard*, May 1859; *Tracy 3113*, 3 May 1896, Columbus. SOUTHERN STATES: *Buckley.*

3. ONOSMODIUM MOLLE Michx.

Onosmodium molle Michx. Fl. Bor. Am. **1**: 133. 1803; not of late American authors.

An erect, much-branched perennial, about 6–7 dm. high, the stem below the branches hispid or in age appressed-strigose, the branches rather densely clothed with short, soft pubescence: larger leaves about 2 cm. broad and 5 cm. long, densely soft-pubescent all over with whitish hairs, the pubescence above and on the veins below spreading, the papillose character of some of the pubescence on the upper surface of the leaves hidden by the density of the pubescence; leaves lanceolate or narrowly ovate-lanceolate, acute, the lateral veins about three pairs: branchlets 3–12 cm. long, the bracts resembling reduced leaves: fruiting pedicels stout, less than 4 mm. long: calyx-lobes 6 mm. long, linear-oblong, obtuse or obtusish, barely twice the length of the nutlets, whitish-pubescent, not strongly nerved: corolla 8–12 mm. long, the triangular-acute lobes 2–3 mm. long, the pubescence on the exterior of the corolla confined almost entirely to the lobes: nutlets less than 3 mm. long, obtusish, usually strongly pitted for the genus, and often somewhat constricted at the base.

This species was founded by Michaux on a plant collected near Nashville, Tennessee, and the above description is largely based on fruiting specimens gathered near the same place by the collectors for the Biltmore Herbarium, and on flowering specimens collected by Dr. Gattinger. The western species to which this name has been applied by the later botanists differs from this one in the larger, less pitted, and never constricted nutlets; in the corolla, which is larger and much more pubescent externally; in the longer strongly-nerved sepals; and in being a much rougher plant.

Onosmodium hispidissimum, with its hispid stem and noticeably constricted nutlets, is easily distinguished.

As far as known *Onosmodium molle* is confined to the barrens of Tennessee and Kentucky, and is a comparatively rare plant in collections.

SPECIMENS EXAMINED. KENTUCKY: *C. W. Short*, 1840. TENNESSEE: *Gattinger*, May, Cedar Barrens of Middle Tennessee; *Biltmore Herbarium 5702*, 7 August 1895, Nashville.

4. **Onosmodium hispidissimum** nom. nov.

Onosmodium carolinianum of American authors; not *Onosmodium carolinianum* A. DC. Prodr. **10**: 70. 1846; nor *Onosmodium molle* Michx. Fl. Bor. Am. **1**: 13. 1803; nor *Lithospermum carolinianum* Lam. Tabl. Encyc. **1**: 367. 1791.

An erect perennial, often 9–12 dm. high, strongly branching above, the branches spreading or ascending; stem and branches thickly covered with spreading hispid whitish (or in the inflorescence yellowish-white) hairs 2–4 mm. long, the branches and often the stem also appressed-pubescent: leaves typically lanceolate, 8 cm. long and 14 mm. wide, sometimes 2.5 cm. wide and 1 dm. long, acute or acutish, tapering to the sessile base, prominently 5–7-nerved on both surfaces, strongly covered with whitish or sometimes yellowish-white spreading papillose hispid hairs above and on the veins beneath, and appressed-strigose between the veins beneath: bracts 8–16 mm. long, resembling the leaves in outline: fruiting pedicels from very short to 4 mm. long: calyx-lobes linear-oblong, obtuse or obtusish, 4–6 mm. long, strongly hispid with yellowish-white hairs: corolla (in earlier flowers, at least) 14–18 mm. long, twice the length of the flowering calyx, sparingly canescent outside below the lobes, but usually strongly canescent and with strongly developed tufts of hairs at the tip of the broadly triangular-acute lobes, which are about 3 mm. long:

nutlets 2–3 mm. long, very obtuse to acutish, strongly constricted at base, suborbicular to ovoid, dull, little if at all pitted.

Onosmodium carolinianum A. DC. is based on *Lithospermum carolinianum* Lam. and on *Onosmodium molle* Michx., the last named being cited as a synonym. That *O. molle* is distinct admits of little question. The short description of *Lithospermum carolinianum* given by Lamarck lays particular stress on its *obtuse* corolla-lobes, a character which shows it is not an *Onosmodium*. He also speaks of its ovate-lanceolate leaves. His description certainly does not answer to the plant to which the name *O. carolinianum* is applied by American authors. DeCandolle himself in taking up this latter name noticed the discrepancies between the descriptions of Lamarck and Michaux, and asked if there were not two species. He apparently knew neither of the species himself. In addition to this, Dr. Britton has kindly examined the specimen of *Lithospermum carolinianum* in Lamarck's herbarium in Paris. It is *Lithospermum Gmelini* (Michx.) A. S. Hitchcock, and was collected by Fraser in Carolina. Being the earliest name for this last species, it should be applied to it. It follows that neither the plant of Lamarck nor the plant of Michaux is the *Onosmodium carolinianum* of authors. Under the circumstances I have given the name of *Onosmodium hispidissimum* to the species now under discussion, it being the most hispid species of the genus.

SPECIMENS EXAMINED. NEW YORK: "*L. E. G.*", Onondaga Valley; *S. B. Buckley*, September 1831, Head of Seneca Lake; *Lucy 764*, Chenango County. VIRGINIA: *Small*, 20 July 1892, Marion, Smyth County; *A. Brown et al.*, 5 June 1890, Roanoke. WEST VIRGINIA: *Millspaugh*, 12 August 1891, Hinton. MARYLAND: *Shriver*, 7 August 1891, Cumberland. NEBRASKA: *Hayden*, 9 June 1853, near Council Bluffs. MISSOURI: *Engelmann*, July 1842, St. Louis; *Bush*, 3 July 1892, Sheffield; *Bush 361*, 15 June 1895, Independence; *Mackenzie 272*, 17 July 1898, Randolph, Clay County; *Mackenzie 1161*, 30 May 1895, Jackson County. KANSAS: *Mackenzie*, 31 May 1897, Wyandotte County. LOUISIANA: *Hale*, Alexandria. TEXAS: *Reverchon 649*, 1880, Dallas. INDIAN TERRITORY: *Palmer 206*.

Onosmodium hispidissimum macrospermum Mackenzie & Bush, var. nov.

Differs from the type principally in the nutlets being larger (4 mm. long) and shining-white: the bracts are also larger and more strongly two-ranked.

This variety, which is often noticeably distinct, is found in Missouri and Illinois in low rich woods or on low prairies, and never on dry hills with the type. The large shining nutlets contrasted with the small dull nutlets of the type are very striking. Type collected by myself near Atherton, Jackson County, Missouri, 7 September 1895.

SPECIMENS EXAMINED. MISSOURI: type specimens; *Bush 363*, 7 September 1895, Atherton (collected at the same time as the type specimens); *Bush 396*, 9 July 1894, Independence, and Jackson County, 2 August 1893. ILLINOIS: *Mead*, Augusta.

5. **Onosmodium occidentale** nom. nov.

Onosmodium carolinianum molle A. Gray, Syn. Fl. **2**^{1}: 205. 1878, and later American authors; not *Onosmodium molle* Michx., *vide supra*.

Usually only 3–6 dm. tall, but occasionally 10–12 dm., branching above or often from near the base, the branches spreading or almost erect; plant clothed all over with a silvery-white or sometimes a slightly yellowish appressed or more or less spreading canescent pubescence (in northern and mountain plants sometimes quite green and noticeably spreading) usually not exceeding 2 mm. in length, the pubescence of the branches and leaves usually appressed: leaves typically about 5 cm. long and 1.5 cm. wide, acutish, prominently 5–7-nerved on both surfaces, the pubescence sometimes strongly spreading and papillose, but most typically soft, appressed and hardly papillose: bracts 6–24 mm. long, often 2-ranked, resembling the leaves in outline: fruiting pedicels from very short to 6 mm. long: calyx-lobes lanceolate, acute, acutish or obtusish, rarely linear-oblong, 6–12 mm. long, canescent or with somewhat spreading hairs: corolla 12–20 mm. long, canescent all over outside, the broadly triangular acute lobes (3–4 mm. long) usually with apical tuft of hairs not strongly noticeable: nutlets 3.5–4 mm. long, ovoid, acutish or acute, not constricted at base, dull in color, little if at all pitted.

This is the common *Onosmodium* of the western part of the country and the most common species in herbaria. It has heretofore been referred to *O. molle* Michx., a species which as already related I believe to be distinct. It ranges from Illinois to Athabasca, Alberta, Montana, New Mexico and Texas, and seems to be a fairly common plant in all this vast extent of country.

SPECIMENS EXAMINED. ILLINOIS: *Buckley*, July 1838; *Riehl 356*, June 1840. MINNESOTA: *Hasse*, 12 July 1882, Union County. IOWA: *Holway*, 12 July 1888, Decorah; *Hitchcock*, 1889, Ames; "*G. W. C.*", 18 September 1895, Des Moines; *Arthur*, 1875, "Iowa"; *Fitzpatrick*, 6 October 1894, Johnson County; *Mackenzie 261*, 12 July 1893, Muscatine County. MISSOURI: *Demetrio*, 30 May 1896, Saline County; *Bush*, 5 August 1893, Atchison County; *Bush 475*, 11 July 1894, and *462*, 1 June 1894, Watson; *Bush*, 6 July 1892, Jackson County; *Bush 532*, and *Mackenzie*, 10 June 1896, Waldo Park, Jackson County; *Mackenzie*, 22 August 1897, Red Bridge; *Mackenzie 322*, 14 August 1898, Lee's Summit; *Mackenzie*, 18 June 1899, Lee's Summit; 1837, St. Louis; *Bush 362*, 13 July 1894, Corning. KANSAS: *Norton 351*, 12 June 1895, Riley County; *Norton & Dorman*, 28 July 1893, Manhattan; 1891, Manhattan; *White*, May 1898, Cowley County; *Kellerman*, 1887, Olathe; *E. E. Gayle*, 18 June 1892, Ft. Riley; *A. B. Snow*, Kansas-Nebraska line; *Oyster*, 10 June 1883, Miami County. NEBRASKA: *Webber*, 4 July 1889, Broken Bow; *Rydberg*, 13 June 1891, Kearney County; *Hayden*, June 1853, Ft. Pierre; *H. Engelmann*, June 1858, Ft. Kearney; *Webber*, July 1889, Lincoln. SOUTH DAKOTA: *Wallace*, 9 July 1896, Corn Creek; *Williams & Corbett 219*, 16 August 1894, Big Stone; *L. W. Carter*, 8 August 1897, Devils' Tower; *Rydberg*, 16 June 1892, Hot Springs. NORTH DAKOTA: *M. A. Brannon 267*, 20 June 1896, Grand Forks; *Williams*, July 1889, Brookings (Dakota). MANITOBA: *E. S. Thompson*, 1898. ALBERTA: *Macoun 23965*, 24 August 1897, McLeod. ATHABASCA: *Macoun 11841*, 3 August 1895, Belly River. MONTANA: *Williams*, 5 June 1886, Big Falls of Missouri. WYOMING: *A. Nelson 206*, 20 July 1894, Hartville; *Pammel & Stanton 9*, 6 June 1897, Sheridan; *Tweedy 3576*, 15 June 1900, Sheridan, and *2596*, September 1899, Dayton. COLORADO: *Hulse*, 1870; *Britton*, 8 October 1882, Golden; *Osterhout 2461*, 25 June 1901, Boulder; *J. H. Cowen*, 10 July 1893, Ft. Collins; *Jones*, 12 June 1878, Platte River, Denver; *Engelmann*, 6 August 1874, Empire; *Brandegee*, 9 July 1873, Cañon City; *Cowen*, 25 June 1895. TEXAS: *Reverchon*, 1880, Dallas, and 3 March 1884, Industry; *Lindheimer; Hall*, 26 May 1872, Burton. NEW MEXICO: *Fendler*, 1847. MISC.: Frémont's Expedition to Rocky Mountains, 1842, *no. 814*, Walla Walla to Ft. Benton; 10 June 1881, Long's Expedition to Missouri River.

Onosmodium occidentale sylvestre var. nov.

An erect perennial, apparently about 10–12 dm. high, the stem below the branches densely pubescent with spreading whitish rather soft hairs 2–4 mm. long, the hairs on the branches more appressed, but many of them also spreading; branches spreading or ascending at maturity, 2–3 dm. long, usually forking; leaves lanceolate, entire or slightly undulate, the main stem-leaves 7–10 cm. long and 2.5 cm. wide or a little less, acute at apex, tapering to the sessile or very nearly sessile base, the 3–4 pairs of lateral veins prominent on both sides, the leaves papillose-hispid above, softly pubescent below, especially on the veins: bracts strongly 2-ranked, ovate-lanceolate or narrower, the lower 3 cm. long and 12 mm. wide, the terminal ones half that size: fruiting pedicels stout, 4–8 mm. long: calyx-lobes 10 mm. long, linear-oblong, acutish, 3–4 times the length of the nutlets, strongly rather short-pubescent: late corolla 9 mm. long, short-canescent outside, the tips somewhat hairy, the lobes deltoid in outline, 2 mm. long, acute but not acuminate: nutlets whitish, shining, 5 mm. long, ovate, acute, not constricted at base and little pitted.

This variety has the aspect and habit of *Onosmodium hispidissimum*, but differs in its non-constricted nutlets. From typical *O. occidentale* it differs in its larger size, more spreading and shaggy pubescence, smaller nutlets and less canescent corolla. From *O. bejariense* it differs in its merely acute corolla-lobes and in having leaves not strongly paler beneath than above, as well as in geographical range. It may well be specifically distinct from *Onosmodium occidentale*, but as that species is very variable, I have concluded to retain it as a variety merely. It seems to be confined to the region around St. Louis, being found in both Illinois and Missouri. The type was collected by *Dr. Engelmann* on July 21, 1861, in woods in the American bottom in Illinois opposite St. Louis, and is in the herbarium of the Missouri Botanical Garden.

SPECIMENS EXAMINED. ILLINOIS: type specimens; *A. S. Hitch-*

cock, 17 July 1890, Fish Lake. MISSOURI: *Eggert*, 12 July 1877, St. Louis.

6. ONOSMODIUM BEJARIENSE A. DC.

Onosmodium bejariense A. DC. in DC. Prodr. **10**: 70. 1846.

An erect perennial, about 6–9 dm. high, branching above, the branches ascending; stem, especially below the branches, strongly hispid pubescent with white or whitish hairs 4–6 mm. long; branches softly appressed-pubescent, also with numerous spreading whitish hairs 2–4 mm. long: leaves lanceolate or the lower oblanceolate-spatulate and long-tapering at the base, the well-developed stem-leaves 8–13 cm. long and 14 mm. wide, acute, sessile, strongly 5–7-nerved, the nerves prominent on both surfaces, softly appressed-pubescent below, or sometimes nearly glabrous between the veins, occasionally with spreading pubescence also on the veins, strigose-pubescent with papillose hairs above, noticeably paler beneath than above, at least in the case of the later leaves: pedicels 6 mm. long or less, the calyx-lobes linear-lanceolate, 8–10 mm. long, acute, appressed-pubescent and long-ciliate at base: well-developed corollas 14 mm. long, very finely canescent outside, often appearing nearly glabrous, and with a few spreading hairs on the lobes, the lobes 3–4 mm. long, triangular in outline, but tapering to a long-acuminate often abruptly bent apex: nutlets 3 mm. long, obtusish or acutish, from little to quite noticeably constricted at base.

A species as yet known only from southwestern Texas, from whence it was first described.

SPECIMENS EXAMINED. TEXAS: *Lindheimer*, 1848, New Braunfels; *Wilkinson 89*, 1897, and *125*, San Antonio; *Lindheimer*, 1844, Brazos; *Jermy*, Gillespie County; *Stanfield 98*, San Marcos; *Bush 1208*, 24 March 1902, San Antonio.

7. ONOSMODIUM SUBSETOSUM Mackenzie & Bush

Onosmodium subsetosum Mackenzie & Bush; Small, Fl. Southeast. U. S. 1001. 1903.

An erect perennial, about 6–10 dm. high, branching above, the branches ascending; stem very glabrous, with the exception of a very few short widely scattered appressed hairs; branches appressed-pubescent with very short white hairs, the pubescence not at all spreading: leaves lanceolate, 9 cm. long or less, 10–18 mm. wide, typically 2.5 cm. long and 14 mm. wide, strongly acute, tapering to the sessile or very nearly sessile base, prominently 5–7-nerved, appressed papillose-hispid above and whitish appressed-pubescent below: bracts 12–24 mm. long, resembling the leaves in outline: pedicels 3–6 mm. long (at least in fruit): calyx-lobes oblong, obtuse, 6 mm. long, hairy on both sides with short somewhat spreading white hairs, and more or less ciliate: corolla 10 mm. long, twice the length of the flowering calyx, soft-canescent above outside, its lobes triangular in outline, acute, barely 2 mm. long: nutlets ovoid, obtuse or acutish, 2–3 mm. long, little if at all constricted at base, but sometimes quite pitted.

This species differs from all others known to me in the glabrous stem (not branches), which strikingly differentiates it. It is confined to the Ozark Mountain region of Missouri and Arkansas, and is usually labeled "*Onosmodium virginianum*" in herbaria, but it has no close affinity to that species. The type was collected by B. F. Bush, *no. 135*, near Eagle Rock, Missouri, in barrens, July 11, 1897.

SPECIMENS EXAMINED. MISSOURI: type specimens; *Mackenzie*, 28 September 1896, Eagle Rock, Barry County; Greene County; *Dewart*, 3 June 1892, Potosi; *Eggert*, 5 June 1892, St. Francois County; *J. W. B.*, 19 May 1881, Willard; *Trelease*, 13 October 1897, St. Francois County; *Bush*, 20 July 1891, and 12 October 1893, Shannon County. ARKANSAS: *Glatfelter*, 17 July 1898, Eureka Springs.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Anderson, J. P. Thalloid liverworts of Decatur County. Iowa Nat. **1**: 33, 44. Ap 1905.

Bauer, E. *Musci* alegrenses. Enumération de mousses et hépatiques récoltées par M. Ed. Martin Reineck et M. Josef Czermack en 1897–1899 au Brésil. Rev. Bryol. **32**: 11. 1905.

Beal, W. J. Plants that hide from animals. Pop. Sci. Mo. **67**: 178–183. *f. 1–8.* Je 1905.

Beal, W. J. The vitality of seeds. Bot. Gaz. **40**: 140–143. 16 Au 1905.

Bentley, J. Pitch pine in Pike County, Pennsylvania. Forestry Quart. **3**: 1–17. F 1905. [Illust.]

Berger, A. A systematic revision of the genus *Cereus* Mill. Ann. Rep. Missouri Bot. Gard. **16**: 57–86. *pl. 1–12.* 1905.

Berry, E. W. The ancestors of the big trees. Pop. Sci. Mo. **67**: 465–474. *f. 1–4.* S 1905.

Bessey, C. E. Life in a seaside summer school. Pop. Sci. Mo. **67**: 80–89. My 1905. [Illust.]

The Minnesota Seaside Station, Port Renfrew, British Columbia.

Bolley, H. L. New work upon wheat rust. Science II. **22**: 50, 51. 14 Jl 1905.

Dammer, U. Zwei neue amerikanische Palmen. Bot. Jahrb. Beibl. 80: 31–33. 13 Je 1905.

Wendlandiella gracilis gen. et sp. nov., from Brazil, and *Geonoma Donnell-Smithii* sp. nov., from Guatemala.

Dandridge, D. Trees in winter. Garden **67**: 56, 57. 28 Ja 1905.

Dean, A. L. On proteolytic enzymes — II. Bot. Gaz. **40**: 121–134. 16 Au 1905.

De Vries, H. A visit to Luther Burbank. Pop. Sci. Mo. **67**: 329–347. Au 1905. [Illust.]

Dietel, P. Ueber die Arten der Gattung *Phragmidium*. Hedwigia **44**: 112. *pl. 4.* 31 Ja 1905; 113–132. 13 Mr 1905.

Includes descriptions of 4 new American species.

Eastman, C. R. On the spelling of "clon." Science II. **22**: 206. 18 Au 1905.

Eastwood, A. A handbook of the trees of California. Occ. Papers Calif. Acad. Sci. **9**: 1–86. *pl. 1–57.* 8 Jl 1905.

Edwards, H. T. The vegetable fibers of the Philippine Islands. Pop. Sci. Mo. **67**: 222–230. *f. 1–3.* Jl 1905.

Evans, A. W. A remarkable *Ptilidium* from Japan. Rev. Bryol. **32**: 57–60. *f. 1–6.* 1905.

P. Bisseti (Mitt.) Evans.

Faull, J. H. Development of ascus and spore formation in *Ascomycetes*. Proc. Boston Soc. Nat. Hist. **32**: 77–113. *pl. 7–11.* Je 1905.

Fitzpatrick, T. J. Additions to the bibliography of Rafinesque. Iowa Nat. **1**: 10–21. Ja 1905.

Fitzpatrick, T. J. The Iowa bladderworts. Iowa Nat. **1**: 30–33. Ap 1905.

Fitzpatrick, T. J. Plants new or little known to the flora of Iowa. Iowa Nat. **1**: 22–24. Ja 1905.

Fletcher, J. Botanical notes. Ottawa Nat. **19**: 110. 8 Au 1905.

The fruit of *Epigaea repens*; rare Ottawa plants.

Gepp, A. & E. S. Atlantic algae of the "Scotia." Jour. Bot. **43**: 109, 110. Ap 1905.

Collected chiefly off the coast of Brazil.

Gepp, A. & E. S. Notes on *Penicillus* and *Rhipocephalus*. Jour. Bot. **43**: 1–5. *pl. 468.* Ja 1905.

Including description of *P. pyriformis* sp. nov., from the West Indies and Florida.

Goebel, K. The fundamental problems of present-day plant morphology. Science II. **22**: 33–45. 14 Jl 1905.

Greene, E. L. New British Columbian *Rosaceae*. Ottawa Nat. **18**: 215, 216. 14 Mr 1905.
New species in *Malus* and *Fragaria* (2).

Greene, E. L. A new papaveraceous genus. Pittonia **5**: 293, 294. 10 Je 1905.
Petromecon, a segregate from *Eschscholtzia*, with the description of a new species.

Greene, E. L. Revision of *Eschscholtzia*. Pittonia **5**: 205–293. 10 Je 1905.
Recognizes 112 species, of which 84 are described as new.

Greene, E. L. A study of *Dendromecon*. Pittonia **5**: 295–306. 10 Je 1905.
Recognizes 17 species, of which 14 are described as new.

Greene, E. L. Suggestions regarding *Sanguinaria*. Pittonia **5**: 306–308. 10 Je 1905.
With descriptions of 4 new species.

Greenman, J. M. A new *Krynitzkia*. Bot. Gaz. **40**: 146, 147. 16 Au 1905.
K. Suksdorfii sp. nov., from the state of Washington.

Hanmer, C. C. A note regarding the discharge of spores of *Pleurotus ostreatus*. Torreya **5**: 146, 147. 26 Au 1905.

Harris, J. A. The dehiscence of anthers by apical pores. Ann. Rep. Missouri Bot. Gard. **16**: 167–257. 1905.

Hedgcock, G. G. A disease of cauliflower and cabbage caused by *Sclerotinia*. Ann. Rep. Missouri Bot. Gard. **16**: 149–151. *pl. 32–34*. 1905.

Hedgcock, G. G. A disease of cultivated agaves due to *Colletotrichum*. Ann. Rep. Missouri Bot. Gard. **16**: 153–156. *pl. 35–37*. 1905.

Hedgcock, G. G. Some of the results of three years' experiments with crown gall. Science II. **22**: 120–122. 28 Jl 1905.

Hemsley, W. B. *Swietenia Mahogani* Jacq. var. *praecociflora* Hemsl. Hook. Ic. Pl. IV. **8**: *pl. 2786*. Ja 1905.
A new variety, described from plants cultivated in Trinidad.

Hennings, P. Einige schädliche parasitische Pilze auf exotischen Orchideen unserer Gewächshäuser. Hedwigia **44**: 168–178. 13 Mr 1905.

Hennings, P. *Fungi* amazonici IV. a cl. Ernesto Ule collecti. Hedwigia **44**: 57–71. 31 Ja 1905. [Illust.]
With descriptions of 47 new species in 36 genera, of which 2 are new.

Hieronymus, G. *Aspleniorum* species novae et non satis notae. Hedwigia **44**: 193–198. *pl. 6*. 29 Ap 1905.
Includes *A. galipanense* sp. nov. from Venezuela.

Hieronymus, G. Einige Berichtigungen zu der Abhandlungen: "Plantae Lehmannianae in Guatemala, Colombia et Ecuador regionibusque finitimis collectae, additis quibusdam ab aliis collectoribus ex iisdem regionibus allatis determinatae et descriptae; *Pteridophyta.*" Hedwigia **44**: 179, 180. 13 Mr 1905.

Hieronymus, G. Plantae Lehmannianae in Guatemala, Colombia et Ecuador regionibusque finitimis collectae, additis quibusdam ab aliis collectoribus ex iisdem regionibus allatis determinatae et descriptae. *Pteridophyta* [continuatio]. Bot. Jahrb. **34**: 561–582. 20 Ja 1905.

Including new species in *Gleichenia* (2) and *Lycopodium* (3).

Hieronymus, G. *Polypodiorum* species novae et non satis notae. Hedwigia **44**: 78–105. 31 Ja 1905.

Contains much relating to American species, including *P. Sintenisii* sp. nov. from Porto Rico.

Hitchcock, A. S. The identification of Walter's grasses. Ann. Rep. Missouri Bot. Gard. **16**: 31–56. 1905.

Höck, F. Hauptergebnisse meiner Untersuchungen über die Gesamtverbreitung der in Nord-Deutschland vorkommenden Allerweltspflanzen. Beih. Bot. Centralb. **18**[2]: 394–416. 1905.

Holm, T. *Anemiopsis californica* (Nutt.) H. et A. An anatomical study. Am. Jour. Sci. IV. **19**: 76–82. *f. 1–6.* Ja 1905.

Holm, T. *Croomia pauciflora* Torr. An anatomical study. Am. Jour. Sci. IV. **20**: 50–54. *f. 1.* Jl 1905.

Holmberg, E. L. *Zephyranthes jujuyensis* Holmb. n. sp. Anal. Mus. Nac. Buenos Aires III. **4**: 523, 524. 19 Ja 1905.

Jordan, D. S. Some experiments of Luther Burbank. Pop. Sci. Mo. **66**: 201–225. Ja 1905. [Illust.]

Kindberg, N. C. New North American *Bryineae.* Rev. Bryol. **32**: 33–38. 1905.

Descriptions of 26 new species in 18 genera.

Klugh, A. B. Some of the rarer plants of Wellington County, Ont. Ottawa Nat. **18**: 217–219. 14 Mr 1905.

Kränzlin, F. *Orchidaceae* americanae. Bot. Jahrb. Beibl. **80**: 7–10. 13 Je 1905.

Descriptions of 6 new South American species, in 5 genera.

Life, A. C. Vegetative structure of *Mesogloia.* Ann. Rep. Missouri Bot. Gard. **16**: 157–160. *pl. 38.* 1905.

Lloyd, F. E. A botanical laboratory in the desert. Pop. Sci. Mo. **66**: 329–342. F 1905. [Illust.]

The Desert Botanical Laboratory of the Carnegie Institution, at Tucson, Arizona.

McCallum, W. B. Regeneration in plants. Bot. Gaz. **40**: 97–120. *f. 1–14.* 16 Au 1905.

MacDougal, D. T. Hugo de Vries. The Open Court **19**: 449–452. *portrait.* Au 1905.

MacDougal, D. T. The suwarro, or tree cactus. Jour. N. Y. Bot. Gard. **6**: 129–133. *f. 31, 32.* Au 1905.

Mackenzie, K. K. & Bush, B. F. New plants from Missouri. Ann. Rep. Missouri Bot. Gard. **16**: 102–108. 1905.

New species in *Sagittaria*, *Heuchera*, *Convolvulus*, *Dasystoma*, *Xanthium* and *Senecio*.

Martin, H. M. Studies on the effect of some concentrated solutions on the osmotic activity of plants. Bull. Torrey Club **32**: 415–429. 28 Au 1905.

Maublanc, A. Espèces nouvelles de champignons inférieurs. Bull. Soc. Myc. France **21**: 87–94. *pl. 6, 7.* 5 Ap 1905.

Includes descriptions of new Brazilian species in *Leptosphaeria* (2) and *Pestalozzia* (2).

Millspaugh, C. F. & Loesener, T. Plantae a clariss. Ed. et Caec. Seler in Yucatan collectae. Bot. Jahrb. Beibl. **80**: 11–30. 13 Je 1905.

Includes descriptions of 8 new species in 6 genera, of which 2 are new.

Moore, A. C. Sporogenesis in *Pallavicinia.* Bot. Gaz. **40**: 81–96. *pl. 3, 4.* 16 Au 1905.

Morgan, T. H. The origin of species through selection contrasted with their origin through the appearance of definite variations. Pop. Sci. Mo. **67**: 54–65. My 1905.

Pampanini, R. Le Cunoniacee degli erbarî di Firenze e di Ginevra. Ann. di Bot. **2**: 43–106. *pl. 5–7.* 10 Ja 1905.

New American species are described in *Belangera* and *Weinmannia* (3).

Peck, C. H. Report of the State Botanist, 1904. N. Y. State Mus. Bull. **94**: 1–58. *pl. 87–93 + P–R.* Jl 1905.

Includes new species in *Amanita*, *Boletus* (3), *Clavaria* (2), *Cortinarius*, *Lactarius* (2), and *Pholiota.*

Piper, C. V. *Poa gracillima* Vasey and its allies. Bull. Torrey Club **32**: 435–437. 28 Au 1905.

Pollard, C. L. On the spelling of "clon." Science II. **22**: 87, 88. 21 Jl 1905.

Porsch, O. Beiträge zur "histologischen Blütenbiologie." I. Ueber zwei neue Insektenanlockungsmittel der Orchideenblüte. Oesterr. Bot. Zeits. **55**: 164–173. *pl. 3.* My 1905; 227–235. *pl. 4.* Je 1905; 253–260. Jl 1905.

Based chiefly upon Brazilian material.

Porsch, O. Neue Orchideen aus Südbrasilien. Oesterr. Bot. Zeits. **55**: 150–163. Ap 1905.
Descriptions of 22 new species in 11 genera.

Reiche, K. Die systematische Stellung von *Lenzia chamaepitys* Phil. Bot. Jahrb. **36**: 82–86. *f. 1.* 28 F 1905.

Rendle, A. B. *Verbena Pritchardii.* Jour. Bot. **43**: 33. Ja 1905.
A new name for *V. bonariensis* Rendle, which was preoccupied.

Röll, J. Beiträge zur Torfmoosflora des Cascadengebirges in Nord-Amerika (Schluss). Hedwigia **44**: 49. 31 Ja 1905.

Rose, J. N. & Painter, J. H. Some Mexican species of *Cracca, Parosela* and *Meibomia*. Bot. Gaz. **40**: 143–146. *pl. 5.* 16 Au 1905.
With new species in *Cracca* and *Meibomia* (4).

Rothrock, J. T. Cucumber tree (*Magnolia acuminata* L.). Forest Leaves **10**: 40. Je 1905. [Illust.]

Rothrock, J. T. Green ash. (*Fraxinus viridis* Michx. f. *Fraxinus lanceolata* Borck.) Forest Leaves **10**: 24. Ap 1905. [Illust.]

Rothrock, J. T. Red ash. (*Fraxinus pennsylvanica* Marshall. *Fraxinus pubescens* Lam.) Forest Leaves **10**: 8. F 1905. [Illust.]

Rothrock, J. T. Striped maple — moose wood. (*Acer pennsylvanicum* L.) Forest Leaves **10**: 56. Au 1905. [Illust.]

Schneider, A. *Chroolepus aureus* a lichen. Bull. Torrey Club **32**: 431–434. *pl. 22.* 28 Au 1905.

Schneider, A. Contributions to the biology of rhizobia. IV: Two coast rhizobia of Vancouver Island, B. C. Bot. Gaz. **40**: 135–139. *f. 1–3.* 16 Au 1905.

Schrenk, H. von. Glassy fir. Ann. Rep. Missouri Bot. Gard. **16**: 117–120. *pl. 20, 21.* 1905.

Schrenk, H. von. Intumescences formed as a result of chemical stimulation. Ann. Rep. Missouri Bot. Gard. **16**: 125–148. *pl. 25–31.* 1905.

Schrenk, H. von. On the occurrence of *Peronospora parasitica* on cauliflower. Ann. Rep. Missouri Bot. Gard. **16**: 121–124. *pl. 22–24.* 1905.

Shafer, J. A. The botanical symposium at Ohio Pyle, Pennsylvania. Torreya **5**: 152–154. 26 Au 1905.

Shaw, G. R. *Pinus Nelsoni.* Gard. Chron. III. **37**: 306, 307. *f. 127.* 20 My 1905.

Sheldon, J. L. Concerning the identity of the fungi causing an anthracnose of the sweet-pea and the bitter-rot of the apple. Science II. **22**: 51, 52. 14 Jl 1905.

Shull, G. H. Stages in the development of *Sium cicutaefolium*. 1–28. *pl. 1–7* + *f. 1–11*. My 1905.
Carnegie Inst. Wash. Publ. No. 30.

Small, J. K. Additions to the flora of subtropical Florida. Bull. N. Y. Bot. Gard. **3**: 419–440. *map*. 27 Ja 1905.
With descriptions of 30 new species in 24 genera.

Spaulding, P. A disease of black oaks caused by *Polyporus obtusus* Berk. Ann. Rep. Missouri Bot. Gard. **16**: 109–116. *pl. 13–19*. 1905.

Spegazzini, C. *Cactacearum* platensium tentamen. Anal. Mus Nac. Buenos Aires III. **4**: 477–521. 19 Ja 1905.
New species are described in *Cereus* (6), *Echinopsis* (12), *Echinocactus* (12), and *Opuntia* (12).

Stephani, F. *Hepaticae* amazonicae ab Ernesto Ule collectae. Hedwigia **44**: 223–229. 29 Ap 1905.
Includes descriptions of 9 new species in 8 genera.

Stevens, F. L. The science of plant pathology. Pop. Sci. Mo. **67**: 399–408. S 1905.

Sudworth, G. B. A new species of juniper for Texas. Forestry and Irrig. **11**: 203–206. *f. 1–4*. My 1905.
Juniperus Pinchoti sp. nov.

Therese Prinzessin von Bayern. Auf einer Reise in Südamerika gesammelte Pflanzen. Beih. Bot. Centralb. **18**^{2}: 523–526. 1905.

Thomson, R. B. The megaspore-membrane of the gymnosperms. Univ. Toronto Stud. Biol. **4**: 1–64. *pl. 1–5*. 1905.

Thomson, R. B. Preliminary note on the *Araucarineae*. Science II. **22**: 88. 21 Jl 1905.

Trelease, W. Illustrations of a "strangling" fig tree. Ann. Rep. Missouri Bot. Gard. **16**: 161–165. *pl. 39–45*. 1905.

Ule, E. Die Kautschukpflanzen der Amazonas-Expedition und ihre Bedeutung für die Pflanzengeographie. Bot. Jahrb. **35**: 663–678. *f. 1–3*. 18 Ap 1905.
New species are described in *Hevea* (3), *Sapium* (2), and *Castilloa*.

Ule, E. Wechselbeziehungen zwischen Ameisen und Pflanzen. Flora **94**: 491–497. 11 My 1905.

Vickers, A. Liste des algues marines de la Barbade. Ann. Sci. Nat. IX. **1**: 45–64. Ap 1905; 65, 66. My 1905.
New species are described in *Cladophora*, *Ectocarpus* (3), *Acrochaetum*, *Nemalion*, *Chondria*, *Thuretia*, *Griffithsia*, *Monospora* and *Rhodochorton*.

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BULLETIN

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OCTOBER, 1905

A new method of measuring the transpiration of plants in place *

WILLIAM AUSTIN CANNON

Very early in the history of the Desert Botanical Laboratory, it was recognized that the study of the transpiration of desert plants ought to be one of the leading lines of research. It was appreciated also that to be most effective the study should be confined as far as possible to plants growing under natural conditions, that is, to plants in the field.

That the task is not without its difficulties is readily seen. The forms of apparatus in general use are not intended and in fact are not well adapted for the determination of the transpiration of plants in place. It was necessary therefore in the very beginning to revise old methods, or to originate and to perfect a new one, both of which have been done.†

It is not to be understood that the method to be described, which was devised to meet the special need, is either ideal or has reached its final stage of development. But the use of it for a year in many experiments out-of-doors and under different conditions has shown it to be so practicable that a description of it at this time, together with some reference to experiments performed with it, appears to be desirable.

THE POLYMETER METHOD

Several methods are in general use by which the amount of watery vapor given off by plants may either be estimated, or

* Papers from the Desert Botanical Laboratory of the Carnegie Institution, No. 5.

† This paper is devoted to the exposition of the method most used in 1904. Others are now being tried; should any of these appear to be satisfactory they will be described at another time.

[The BULLETIN for September (32 : 451–514) was issued 21 S 1905.]

demonstrated. These methods may be grouped into three classes. In the first of these the plant is potted, and weighed at intervals; the loss of weight is assumed to be due to the evaporation of water from its surface. In a second class the plant is enclosed in a tight receptacle and the vapor evolved from it is collected in some kind of drying material which is weighed before and after the experiment; any increase in weight is attributed to the absorption of water which was derived from the plant. In the third class the amount of water transpired is estimated from the amount absorbed by the plant. The apparatus employed in this class is some form of potometer.

The mere demonstration of the fact of transpiration has been made by placing the plant, or a portion of it, in a tight receptacle which encloses at the same time some hygroscopic material. The increase in the amount of vapor in the receptacle, or the presence of any considerable amount, is indicated by some visible change, as in the color or position, taking place in the substance.*

The method most used the past season at the Desert Botanical Laboratory is in principle a departure from any given above. It consists essentially in the determination of changes in the absolute humidity of the atmosphere in which the plant is placed; the difference in the absolute humidity, expressed in fractions of a gram, is the amount of vapor transpired. The calculations by which the absolute humidity is derived are based on variations of the relative humidity.

AN ACCOUNT OF THE APPARATUS

The form of apparatus with which, as was mentioned above, the most of the transpiration studies in the field were carried on during the past season at the Desert Botanical Laboratory was suggested early in 1904 by Dr. D. T. MacDougal of the Advisory Board of the laboratory. This is the apparatus used in the polymeter method for the determination of transpiration (see FIGURE 1).

The apparatus consists of a hygrometer, a bell-glass and a water-proof base. The form of hygrometer used was Lambrecht's *Reise* Polymeter. This instrument is especially constructed to record a variety of meteorological conditions; it is, however, well

* For a more detailed account of the methods used in studying the transpiration of plants, see BURGERSTEIN, Die Transpiration der Pflanzen, 1904.

adapted to this other use. It is a substantially made brass instrument which carries a hair hygrometer and a thermometer, and is provided with a solid base which enables the instrument to stand

FIGURE 1. Apparatus for determining the transpiration of plants in place. The polymeter method.

upright when in use. The hygrometer indicates the relative humidity, and it is also provided with a scale by which the temperature of the dew-point may be approximately determined. The maximum vapor-pressure for any temperature is written on the thermometer, which unfortunately is graduated according to the Fahrenheit scale. This instrument provides a means of telling

FIGURE 2. *Covillea tridentata*, showing base made of cement which was made water-proof by being covered by a mixture of vaseline and wax.

directly, therefore, the temperature of the air, the maximum vapor-pressure, the relative humidity, and the dew-point. From what has been said regarding the polymeter it will appear at once that it can be used to demonstrate the fact of transpiration, and if the cubic contents of the bell-glass are known, from data given by it the amount of transpiration can also be estimated.

Any bell-glass which is adapted in form and in size to the plant, or branch, experimented with may be employed. Perhaps the best shape for general use is that of the bell shown in FIGURE 1, the enlarged upper portion of which permits the natural spreading of the plant. The size of the bell is of much importance, since it must correspond with the rate of transpiration. It can only be told by experience.

FIGURE 3. *Encelia farinosa*, with base constructed of wood. The base is made of two boards of which the one to the left is securely fastened to two cleats, which carry buttresses on the free ends, and the one to the right is clamped into position by interposing two wedges between the buttresses and the loose board. By removing the wedges the base is easily taken apart.

Finally, a base upon which to set the bell-glass and the polymeter must also be provided. The form may vary according to the nature of the experiment. If an entire plant is under observation, a cement base may be used (FIGURE 2). But this form, which was originally devised to be in a measure permanent, is not altogether satisfactory. A very good base for general use can be made of wood, like the one shown in FIGURE 3, for example, and it can be made so that it can be put together or taken apart quickly and with ease. Another form, shown in FIGURE 4, is made of an

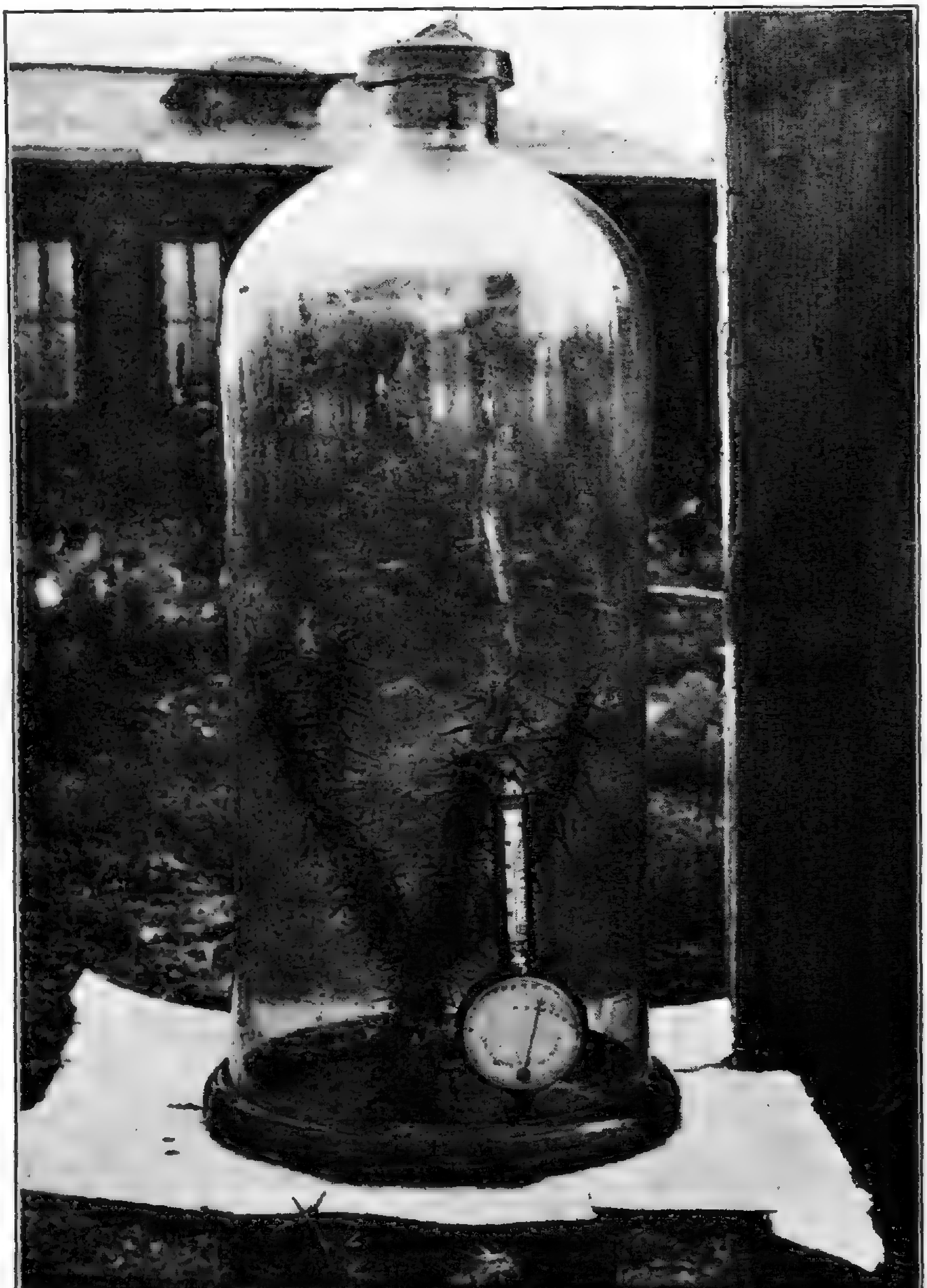

FIGURE 4. Method of observing the transpiration of a branch while still attached to the main plant. The plant is *Opuntia versicolor*.

ordinary plant drier, which like the other forms of base described has been made water-proof by the application of vaseline or some other water-resisting substance. It sometimes happens that it is impossible or extremely inconvenient to use any of the bases above described. I have, for instance, carried the transpiration apparatus, packed on the back of a horse, for some miles into the mountains when it was necessary to make the load the lighest possible. In

FIGURE 5. The manner of using the polymeter method in studying the transpiration of a mistletoe, *Phoradendron californicum*.

such a case oiled cloth of some sort was substituted with success for the heavier and more cumbersome forms of base. A cloth base is also frequently more convenient when studying the transpiration of such a plant as the mistletoe (FIGURE 5), or a branch of a tree. Whatever may be the style of base used, great care must be taken to avoid any leakage which would render the results quite untrustworthy.

A very necessary addition to the apparatus as above presented, in this country of high temperatures and bright sunlight, is some form of shade. Several types have been used. The one given in FIGURE 1 is perhaps the most satisfactory. It is made of heavy white duck. Straps are attached so that it can be fastened to camera tripods; it is thus easily carried and is very rigid when spread, and flaps are sewed to the bottom, upon which stones are piled to ensure a safe anchorage against the winds.

The manner of setting up the apparatus is very simple. As soon as the base is arranged, the polymeter is placed upon it in a position where it may be readily observed, and the bell-glass is placed over the plant and the polymeter and sealed quickly and tightly to the base. The entire apparatus is shielded from the direct sunlight, which can be done just before or immediately after the bell is put in position. The adjustment of the apparatus need not take longer than three or four minutes.

When the apparatus is set up, the time, the relative humidity and the temperature are at once taken and recorded. The readings should be repeated at frequent and regular intervals.

THE CALCULATION OF THE ABSOLUTE HUMIDITY

The amount of moisture in the atmosphere of the bell-glass may be found by a simple calculation, which may be based wholly, or if preferred only in part, on data provided by the polymeter. The manner of reducing the observations in both instances may be illustrated by the data given in the following experiment:

Time	Relative humidity	Temperature
9:33 A. M.	23	29° C. (84.2° F.)
10:00 "	50	The same

The bell has a capacity of 17,500 c.c.

A method of deriving the absolute humidity with the aid of data given entirely by the polymeter will be given first.

The polymeter gives 30 mm. as the maximum vapor-pressure at 84° F., and this number, 30, expresses also the weight in grams of one cubic meter of water-vapor at that temperature, since for the temperatures that usually occur the vapor-pressure in millimeters is expressed by almost the same number that gives the weight of water-vapor per cubic meter in grams.* That is, a cubic meter of saturated air, at sea-level, and at a temperature of 84° F., weighs (according to the polymeter) 30 grams.† At a saturation of 23 per cent. there would be 6.9 grams in one cubic meter (0.23 × 30). Multiplying this number by that fraction of a cubic meter which the capacity of the bell-glass represents, 0.0175 (17,500/1,000,000), gives 120 milligrams. Therefore, at a temperature of 84° F. and at a saturation of 23 per cent., the meteorological conditions at the beginning of the experiment, there were 120 milligrams of moisture in suspension in 0.0175 of a cubic meter, or in other words in the bell-glass.

If the second reading of the experiment is reduced in like manner it will give 262 milligrams as the amount of moisture which was in the bell-glass at 10:00 o'clock. The difference between 262 and 120 milligrams is the increase in the absolute humidity which is due to the transpiration of the plant. That is, 142 milligrams of watery vapor were given off by the plant in 27 minutes, and from this result the rate for any period and for any surface-area can be easily estimated.

The preceding method of deducing the amount of moisture from readings given by the polymeter is sufficiently accurate for tests, for purposes of demonstration, or for comparison, but is subject to certain very obvious errors. In the first place the vapor-pressure given by the polymeter is not so accurate as that provided by reliable hygrometric tables; ‡ it cannot be read so closely. And, also, the maximum pressure of vapor in millimeters is not expressed at all temperatures that occur outdoors, at any rate in the desert region, by the number that gives the weight of vapor in grams per cubic meter. For example, the thermometer

* HANN, Handbook of Climatology. English translation by R. DeWard, 1903.

† The number on the polymeter is really slightly less at the temperature, but as the scale is so small it cannot well be read more closely.

‡ Smithsonian Meteorological Tables, 1897, have been used in most of the reductions.

in summer not infrequently registers 95° F. (35° C.) in the shade, and often much higher. The weight of a cubic meter of saturated air at 35° C. is 39.187 grams; the maximum vapor-pressure at that temperature is, however, 41.78 mm.* I have, therefore, used the hygrometric tables in making all calculations.

If, now, the absolute humidity is found for the above experiment by employing the hygrometric tables we shall get slightly different results.

The weight of one cubic meter of aqueous vapor at 29° C., and at sea-level, is given as 28.450 grams.† With a relative humidity of 23 per cent. the weight would be 6.54 grams for one cubic meter. Multiplying this by the fraction 0.0175, as before, gives 114 milligrams for the first reading. The second amount reduced in the same manner is 248.8 milligrams. Therefore the total transpiration, according to the latter method of making the computation, is 134.8 milligrams as against 142 by the first method, and this difference becomes greater with the rise of the temperature, since, among other reasons given above, the first method was based upon the pressure of vapor and not on its weight.

It has been mentioned above that the hygrometric tables are computed for sea-level. For delicate hygrometric work, therefore, some correction should be made for the higher altitudes, but for the usual work of estimating the transpiration of plants, partly because it is largely a comparison, slight altitudes above the sea need not be considered. Neither is it necessary to take into account the usual daily variation of the barometer. When on account of a considerable altitude above the sea, as at the Desert Botanical Laboratory (altitude 2,600 feet), it is necessary to take into account the diminished air-pressure, the final deductions for absolute humidity are multiplied by the following fraction:

$$\frac{\text{Gravity at altitude of experiment}}{\text{Gravity at sea-level}}.$$

* Smithsonian Meteorological Tables, 1897, pages 133 and 142.

† *L. c.*, page 133.

TESTING THE POLYMETER METHOD

Laboratory experiments for the purpose of testing the accuracy of the method indicate that the polymeter used for the present object generally registers too low. This is due to the slow diffusion of moisture in a confined space as well as to a tardy reaction of the instrument itself. But these experiments show, on the other hand, the very important fact that when the instrument is handled properly, in a uniform manner, it will give results which are consistent.

The succeeding experiments, which were conducted in the laboratory in a manner to be detailed, give some idea of the behavior of the instrument in regard to the rate of increase or decrease of moisture in the bell-glass.

EXPERIMENT NO. 1. — *Reaction of the polymeter to a change in the relative humidity which is approximately one per cent. a minute.* The apparatus was arranged in the following manner: A bell-glass was placed over a polymeter and sealed to a ground-glass plate. Inlet and outlet tubes were arranged so that the amount of moisture in the bell could be increased or diminished at pleasure. At the beginning of the test the humidity of the atmosphere of the bell-glass was increased to a certain per cent., which was indicated by the polymeter, after which a portion of it was withdrawn and collected in sulphuric acid drying-tubes. The polymeter was again read. The amount of vapor which was taken away from the bell-glass was then computed by the hygrometric method as given in the preceding pages, and it was compared with the amount as determined by the increase in the weight of the drying tubes. According to the polymeter the vapor removed was 88 mg.; the tubes gained 90 mg. in weight. Thirty-seven minutes were taken to remove the moisture from the bell-glass, during which the polymeter recorded a decrease of 33.5 per cent. in the relative humidity.

EXPERIMENT NO. 2. — *Reaction of the polymeter to a variable change in the relative humidity.* The apparatus was set up as before. Calcium chloride drying-tubes were used. A stream of moist air was passed through the bell-glass from 10:41 until 10:47, when all openings were again closed.

The following data were recorded:

Time	Relative humidity	Temperature
10:41	43	74° F.
10:47	61	74
11:10	63	74

It will be observed that the humidity increased 18 per cent. in 6 minutes (10:41–10:47). From 10:47 to 11:10 the instrument was allowed to settle, during which time it showed an increase of 2 per cent. This was due to the tardy response of the polymeter, since the moisture was equally distributed throughout the bell-glass by reason of the manner of introducing it.

At 11:10 the stream of moist air was again sent through the bell-glass; it was stopped at 11:17.

11:17	68	74
11:37	67	75

The rise of 5 per cent. of the humidity in 7 minutes (11:10–11:17) was closely followed by the polymeter, since it showed no change except only a fall of one per cent. due to the higher temperature, in the succeeding period of rest.

At 11:37 a portion of the moisture was removed from the bell-glass and collected in calcium chloride drying-tubes. This process required 12 minutes, during which the humidity fell 25 per cent.

11:49	42	75.5

According to calculations based upon the polymeter, the amount of moisture withdrawn was 42 mg.; the drying-tubes gained 55 mg. That is to say, the polymeter, on account of the too rapid decrease in the humidity, lagged considerably in its recording.

BEST METHODS OF CONDUCTING THE EXPERIMENTS

When an experiment is performed it is necessary to compromise between the desirability of making it as short as possible, in order to maintain conditions for the plant as nearly normal as practicable, and the fact that the instrument, for reasons given above, does not record instantly the humidity of the air. Consequently the rate of increase in the relative humidity should be as nearly constant for all experiments as possible, particularly when comparative studies are carried on, and it should not be over 1 per cent. a minute. This condition is fairly well attained by varying the size of the bell-glass in accordance with the rate of transpiration. It can be told only by trial.

Although the relative humidity of the atmosphere of the bell-glass cannot be lowered to suit the convenience of the operator, without subjecting the plant to grossly unnatural conditions even on the desert, it is altogether best if at the beginning it does not greatly exceed 25 per cent. The experiment can then be so conducted that a considerable range in the relative humidity is possible without greatly modifying the moisture conditions; the range need not be greater, if so ample, as that to which the plant is daily subjected in the open. If this precaution is taken the decrease in the rate of transpiration which accompanies an increase in the humidity can largely be avoided.

The foliage should be uniformly distributed throughout the bell-glass so that the diffusion of the watery vapor may be as quickly attained as possible. This may be facilitated by the use of some device by which the circulation of the air may be maintained.

The temperature can be kept fairly uniform if the apparatus is allowed to become of the same temperature as the plant and the base, provided a permanent base is used, but in case the day is unusually hot and a large increase in heat is observed, notwithstanding the shade, a dampened blotter or cloth tied to the outside of the bell-glass and large enough to cover one-third of its surface, will in a very satisfactory manner keep the temperature down.

SUMMARY AND CONCLUSIONS

The polymeter method has been in use one year, during which time about 100 experiments were performed with it. All of these, with the exception of a single series, were conducted upon plants in place, and the experiments, an account of which will be given at another time, showed very conclusively that the new method is a practicable one for outdoor use. The following summary is given, with sufficient illustrations drawn from the work of the year to give some conception of the scope of the method and more especially of its efficiency.

1. The polymeter method of determining the transpiration of plants is based upon changes in the relative humidity of the atmosphere in which the plants are placed. From data respecting the relative humidity and the temperature, provided by the polymeter, the absolute humidity is calculated by well-known methods. The difference in the absolute humidity constitutes the amount transpired.

2. The results derived from the use of the method are shown by laboratory tests to be consistent, and, provided certain precautions are taken, to be reasonably accurate.

3. The apparatus is easily adjusted, it is not likely to get out of order, and it may be easily transported.

4. The new method is especially suitable for use in a dry locality; where the humidity is high some other method will probably be more satisfactory.

5. That the range of the use of the method outdoors is large will be perceived by the following list which is a part only of the plants studied: *Cereus giganteus*, *Covillea tridentata*, *Encelia farinosa*, *Fouquieria splendens*, *Fraxinus arizonica*, *Phoradendron macrophyllum*, *Pinus ponderosa*, *Quercus oblongifolia*, *Kallstroemia maxima*, and *Verbena ciliata*.

6. It will be observed by the list that not only entire plants in place, but also portions of plants while still attached, can be employed. This greatly enhances the usefulness of the method, as the following indicates: In a certain experiment on a mistletoe and its host, the transpiration of the mistletoe was taken while it was still growing on its host and then the apparatus was readjusted and the rate of the host branch upon which the mistletoe grew was observed. When these experiments were completed the transpiration of a seedling of the same species as the host plant was learned. Thus results of much pathological and physiological importance were surely and readily obtained.

7. It is important to note that a plant can be experimented upon repeatedly without apparent injury, which makes it possible to observe the transpiration at hourly or at daily intervals, and thus to learn the diurnal or the seasonal variations as desirable. As a single instance of seasonal differences in rate, the transpiration of *Fouquieria* may be cited. The absolute seasonal variation

in rate of this plant was 8.03 milligrams per minute for 100 sq. cm. of transpiring surface. The least rate was that of March when 0.22 milligrams for the same area and period was observed, and the highest was in August when the rate was 8.25 milligrams.

8. The apparatus is so sensitive to changes in the humidity — to give an illustration of the delicacy of the method — that it was possible to demonstrate and to estimate the transpiration of *Echinocactus* during the extremely hot and dry climatic conditions of June, at a time when the transpiration of all desert plants was very feeble. It is of interest to observe that the cobalt nitrate method as employed to demonstrate transpiration was quite ineffective as a means of showing any transpiration of the plant.

9. Finally the convenience with which the apparatus may be transported may be mentioned. This feature makes it possible to extend the work into out-of-the-way places, as for example, to study the effects of altitude on the rate of transpiration when the experiments have to be carried on in the mountains. As a single instance of this use of the method the following may be given: Some experiments on *Helenium Hoopesii* were performed at different altitudes in the Catalina Mountains, which are not far distant from the laboratory but which are rough and rather difficult to enter. A portion of the experiments were conducted at an altitude of 7,600 feet and a portion at an altitude of 9,150 feet. The general result of these studies may be summed up by the statement that they tended to support the view that the altitude directly affects the rate of transpiration, which in the present case was greater at the higher altitude.

DESERT BOTANICAL LABORATORY OF THE
CARNEGIE INSTITUTION.

The fruit of Opuntia

James Arthur Harris

In the Bulletin of the Torrey Botanical Club for May, 1905, Professor Toumey * presents notes on the fruits of some species of *Opuntia*. No reference to the literature appears, and this circumstance, in connection with the conclusions drawn from his observations, seems to justify a brief statement of similar observations which have been made upon *Opuntia* and other genera of the *Cactaceae*, and some remarks upon his conclusion. No attempt at a complete bibliography is contemplated.

The writer first considers the dissemination of *O. fulgida*, and concludes that it is accomplished largely by vegetative means, through the densely spiny and brittle terminal branches; and that the pendulous clusters of spineless, succulent fruit, which remain for many months on the tree and in easy reach of cattle and other large grazing animals to which it is very attractive, are all important factors in vegetal dissemination, and that this acquired function of the fruit is gradually influencing its character and its form. "It is certainly changing from its original seed-bearing condition to one of sterility. * * * Plants of this species are occasionally observed bearing clusters of short, spineless branches which externally closely resemble the clusters of proliferous fruits. These clusters of branches serve the same purpose as the fruits in attracting animals. It is possible that they have developed because of the intimate relation between animal life and vegetal dissemination."

The writer then refers to a number of species, as *O. tetracantha*, *O. leptocaulis* and *O. arbuscula*, in which many short, tumid, lateral branches not much larger than the fruits are produced in abundance during dry and adverse seasons, while under more favorable conditions they are almost entirely replaced by fruit.

Propagation and distribution in a vegetative manner is undoubtedly of great importance in *Opuntia* and has occupied the attention of several writers. Goebel refers to several species.†

* Toumey, J. W. Bull. Torrey Club 32 : 235–239. *pl. 9, 10.* 1905.

† Goebel, K. Pflanzenbiologische Schilderungen 1 : 70–72. 1889.

Mammillaria gracilis produces small, nearly spherical, lateral processes of the size of a hazel-nut, which are readily detached, even by a dash of water, or may easily cling to animals. On *O. gracilis*, according to him, one rarely finds flowers and still more rarely fruits; the plant depending apparently entirely upon the brittle branches, which may even be broken off by the wind, for propagation. He also mentions *O. curassavica*, *O. Biglovii* and *O. aurantiaca* as forms in which the easily detached branches readily take root and reproduce the plant.

More recently Toumey himself has published * upon vegetal distribution in *Opuntia* and finds that of fourteen species of *Cylindropuntia* examined in the field all are more or less adapted for dissemination in this manner. The fruits of the larger number of the species are not sterile, but "as a generalization it may be stated that with this great group of plants the adaptations for vegetal dissemination are inversely as their seed production."

In a general study of vegetative distribution among plants, Terracciano pays particular attention to the *Cactaceae*,† confining his observations especially to *Opuntiae* which he was able to observe under cultivation. He recognizes four types of vegetative reproduction and dissemination in the genus and adduces several illustrations of each.

As to Toumey's conclusions concerning vegetative dissemination, there can be no question of the importance of vegetative propagation in the *Cactaceae*, and we may possibly regard some of the structures described as adaptations which have arisen because of their usefulness to the species. At the present time perhaps the tendency is to place too little rather than too much weight upon the idea of adaptation, but it seems that much more evidence should be assembled before the suggestion, that the pendant groups of fruits or the spineless branches resembling them have developed because of the intimate relation of animal life and vegetal dissemination, can be admitted even into ecological theory.

The conclusions concerning the fruit are as follows:

1. The fruit of *Opuntia* is caulome in structure.
2. Its caulome nature is probably of recent development.

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* Toumey, J. W. Bot. Gaz. **20**: 356–361. 1895.

† Terracciano, A. Cont. alla Biol. Veg. **3**: 52–59, 67–68. 1892.

3. It has become caulome by its once superior ovary receding into a vegetative branch, thus making it at present inferior.

4. The branch which now becomes the ovary is usually modified and ripens into the structure which we term the fruit; it may however become but little modified, resembling the ultimate branches and continuing as a vegetative part of the plant.

The first of these conclusions may be freely admitted in so far as any fruit developing from an inferior ovary is to be regarded as caulome. In the *Cactaceae* the similarity of the portion of the fruit derived from the receptacle to the vegetative shoot is greater than in many other forms with an inferior ovary, and the teratological literature affords many illustrations of even more striking resemblance than those furnished by the normal structures. It seems however unnecessary to discuss all the teratological evidence,* since the case is one largely parallel with that of replacement of floral organs by foliage leaves. If one accepts the latter as proof that the elements of the flowers are derived from foliage leaves, he will also regard the fruit of *Opuntia* as derived from the vegetative branch.

The proposition that the fruit of *Opuntia* is caulome in structure is by no means new. It would require an unprofitable amount of labor to try to locate the first suggestion to this effect, but it was certainly more than fifty years ago.

The second statement, that the caulome nature of the fruit is probably of recent development, seems to be open to question. It may be quite true, but no valid evidence is offered in support of it. So far as I am aware the embryological investigations offer no evidence in favor of this point, and our knowledge of the relationships of the *Cactaceae* is too obscure to permit of valid deductions without an examination of all accessory data. It is, however, a quite general opinion that the *Cactaceae* as a group is of recent origin, but the relationships of the groups are very uncertain.

The third assertion, that the fruit has become caulome by its once superior ovary receding into a vegetative branch, thus making it at present inferior, is also much in need of supporting evidence. Here again the evaluation of teratological evidence for special morphological conclusions must largely decide the problem.

* For much of which the reader will consult Penzig's Pflanzenteratologie.

Those who have had much experience with teratological material, however, will be exceedingly cautious in attaching the significance which Professor Toumey does to the one enlarged pistil containing seeds and which has assumed the color of a fruit. Furthermore it hardly need be pointed out that the derivation of a portion of the inferior ovary from the receptacle of the flower, a structure caulome in nature, removes the necessity of accounting for the structure of the fruit by assuming that the ovary has receded into a vegetative branch.

We may examine a few of the published discussions bearing upon this point.

Ramirez * has published descriptions and excellent colored plates of three malformations in the fruits of *Opuntia*. After a considerable discussion of the morphological nature of the inferior ovary he takes up the three deviations observed.

The first case, as he describes it, is one of fusion, consisting of a cladode, or joint of the shoot, bearing at the tip a mature red fruit which, instead of being articulated with the stem as is ordinarily the case, is continuous with it, the two regions being separated merely by a slight constriction of a whitish instead of green or red color; the whorls of spines and the cushions which they subtend are continuous in the two portions of the structure under consideration.

The second case is one designated as the inclusion of a fruit in a cladode which is somewhat thicker in the middle and on one side, but except for this and the presence of the scar at the apex and the more or less normal ovary inside closely resembles one of the familiar vegetative joints.

The third case is one of "lateral proliferation of the fruit" in which a large number of fully developed fruits are borne upon the side of another.

The interpretation which Ramirez has to suggest for these anomalies has, it seems to me, much to commend it. He considers that the ovaries originate in a normal manner, but that in certain regions they undergo a slight modification and that, due to the hereditary tendency of *Opuntia* to form cladodes, the ovary is more or less completely transformed into structures resembling the

* Ramirez, J. Anales Inst. Méd. Nac. 3: 223–227. *pl.* 5–7. 1897.

joints of the stem. It will be seen that the nomenclature used by Ramirez is not in accord with his explanation, a point of minor importance, however. The second case described by Ramirez, and the one upon which he largely bases his interpretation of the first two cases described, is clearly identical with that illustrated by Toumey (*figs. 11* and *12*) as occurring in *O. Engelmanni* as well as a number of other species.

The fruit of *Opuntia Ficus-indica*, "wholly enclosed in one of the well-known flat branches of this plant," described and figured by Ernst,* is in all probability identical with the forms figured by Ramirez and Toumey. Masters † supposes that this case is analogous to the fruit of *Cereus* described by Zuccarini.

This brings us to the consideration of certain interesting anomalies in *Cereus*. In this genus the flowers are normally lateral but occasionally those which are terminal have been observed, as in *C. azureus*, *C. caerulescens*, *C. serpentinus*, *C. speciosissimus* and *C. splendidus*.

Penzig in his Pflanzenteratologie remarks that when the flowers occupy a terminal position, "sie sind dann meist mehr oder minder tief in die Sprossspitze eingesenkt."

The figures which I have examined represent the flower or the fruit as produced directly from the apex of the main axis. Particularly interesting are the description and figure given by Zuccarini,‡ in which a longitudinal section representing the course of the vascular bundles is shown.

In the large collection of succulents at the Missouri Botanical Garden I have been able to examine several of the cases which have been described in the literature, and Mr. Thompson called my attention to a large specimen of *C. baxaniensis* with several terminal fruits, one of which had other flowers developing from the side. A section of one of these fruits showed it to be sterile. In these cases the meristematic region of the stem probably gave rise immediately to floral organs instead of continuing its growth as a vegetative shoot; this has given rise to the impression that the flower or fruit is sunken in the tip of the axis. This explanation may perhaps also apply in some cases to the fruits of

* Ernst, A. Nature **27**: 77. 1883.

† Masters, M. T. Nature **27**: 126. 1883.

‡ Zuccarini, J. G. Abh. Akad. Wiss. München 4^1: 155–161. *pl. 1–2*. 1844.

Opuntia which resemble cladodes, but the other explanation seems the more plausible.

In view of the arguments presented above, the fourth conclusion should be modified to read: "The ovary of *Opuntia* usually ripens into a fruit-like structure, but it may become modified, assuming the features of a vegetative stem, persisting as a vegetative part of the plant and producing flowers or vegetative branches, or becoming detached it may serve as an organ of vegetative reproduction. In many cases the ovules are few or quite abortive, while the portion of the ovary which may be described as caulome in nature persists in the form of a vegetative branch."

In conclusion Professor Toumey remarks:

"The adverse environmental conditions under which *Opuntia* grows is ample reason for this interesting evolution. The ovary which was once superior has gradually become more and more depressed until now it is entirely enclosed in the fleshy branch."

Ganong * suggests the question as to whether there may be a biological reason for the extremely "inferior" nature of the ovary.

It would be highly interesting if such a character as the inferior or superior nature of the ovary could be accounted for as a result of physical environmental conditions, but unfortunately the evidence is entirely inadequate for any such conclusions. Very frequently, as a teratological phenomenon and under physiological conditions for the most part but little understood, a primordium which would normally have developed into a sepal or petal or stamen or carpel, gives rise to any one of the others or to a foliar leaf with the peculiarities of the species. It is not at all remarkable, then, that an inferior ovary should sometimes give rise to leaves or lateral appendages or exhibit other peculiarities of the stem. Of this a larger series of illustrations from various forms might be given. The nature of the vegetative shoot in the *Cactaceae* only makes the condition found in the fruit more striking.

THE LIBRARY, MISSOURI BOTANICAL GARDEN.

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* Ganong, W. F. Bot. Gaz. **20**: 213. 1895.

Studies on the flora of Southern California

LeRoy Abrams

Hookera multipedunculata sp. nov.

Bulbs 2–2.5 cm. broad: scapes several, ascending, 8–15 cm. long, the upper three fourths being exposed above the ground, 1 mm. in diameter: leaves equaling or exceeding the scapes, 5 mm. broad, conduplicate: umbels 5–13-flowered: bracts several, 5 mm. long: pedicels 2–3 cm. long: perianth funnelform, 15 mm. long, rose-purple, its segments 9–10 mm. long, the outer lanceolate, the inner slightly broader: staminodia wanting; stamens 3; filaments 3 mm. long; anthers 5 mm. long: style 6 mm. long: mature capsule oblong-obovate, 5 mm. long.

Closely related to *H. filifolia* (S. Wats.) Greene, but distinguished by the absence of staminodia and by the stalked rather than sessile anthers; the bracts are also much less conspicuous.

Growing in heavy soil near Cuyamaca Lake, San Diego County, *Abrams 3897*, June 25, 1903. The type of this, as well as those of the following new species, is in the Herbarium of the New York Botanical Garden.

Abronia pinetorum sp. nov.

Apparently perennial, from a rather thick, fleshy tap-root; stems branching from the base, ascending or prostrate; herbage glandular-villous throughout: petioles slender, 1–3 cm. long; blades thickish, mostly ovate, obtuse or rounded at apex, cordate or rounded at base, 1–2 cm. long: peduncles 3–6 cm. long: involucral bracts ovate-lanceolate, 5–7 mm. long, acuminate: perianth bright rose-purple; tube slender, 2 cm. long; lobes 5–7 mm. long, rather deeply lobed: wings of fruit rounded at apex and but little prolonged above, forming a broad shallow sinus.

Open pine forests, Thomas Valley, San Jacinto Mountains, *Hall 2166*, June, 1901.

Abronia aurita sp. nov.

Herbage glandular-villous; stems prostrate or nearly so: petioles 1–3 cm. long; blades rather thin, ovate, 15–40 mm. long, oblique at base, margins wavy-crenate: peduncles 4–7 cm. long: bracts narrowly lanceolate, long-acuminate, 1 cm. long: flowers mostly about 20: perianth rose-colored; tube 2 cm. long; lobes

5–6 mm. long, rather deeply lobed: wings of fruit obtuse at apex, much prolonged above forming a deep rather narrow sinus.

The narrow bracts and peculiar wings, which resemble the ears of a coyote, distinguish this best from the preceding species; while the larger flowers readily distinguish both from *A. villosa* S. Wats., with which they have been confused.

Palm Springs, *S. B. Parish 4138*, April, 1896 (type); open sandy plain, Riverside County, *Grant 4444*, 1901; vicinity of Winchester, *Hall 2915*, no date.

Delphinium Cuyamacae sp. nov.

Root rather stout, fasciculately branched 3–5 cm. below the surface, the branches not at all fusiform: stem erect, simple or in large specimens with one or two short slender flowering branches from near the base of the raceme, rather stout and somewhat fistulous below, 4–6 dm. high, pale-green and cinereous with a fine close puberulence: basal leaves on very stout cinereous-puberulent petioles 6–9 cm. long, dissected into rather broadly linear lobes, 2.5–3 cm. broad, densely puberulent beneath, less so above; stem-leaves on closely erect stoutish petioles, similar to the basal but becoming smaller and more dissected: raceme simple, narrow, rather dense above, the lower scattered flowers on pedicels about 2 cm. long, the upper ones on pedicels about 1 cm. long: sepals purple, puberulent without, the lower oval, 8 mm. long, the lateral broadest above the middle, acutish, slightly exceeding the lower; spur straight or nearly so, 3–4 mm. longer than the blade and about 2 mm. broad at the upper end, gradually tapering: lower petals rose-purple, their claws slender, 6 mm. long, the blades rounded in outline, 5 mm. broad, usually cleft to the middle, ciliate on the margin and with a tuft of whitish hairs on the back; upper petals purple except the lower whitish margin, 7 mm. long, 3 mm. broad at the oblique apex: ovary and immature capsules nearly glabrous: mature fruit not seen.

Apparently closely related to *D. Hanseni* Greene, from which it is best distinguished by the character of its pubescence and purple flowers.

On grassy slopes bordering Cuyamaca Lake, altitude 1550 meters, San Diego County, *Abrams 3888*, June 26, 1902.

Acrolasia Davidsoniana sp. nov.

Stems slender, erect, simple below, 3–4 dm. high: leaves linear or linear-lanceolate, 1–3 cm. long, entire: flowers in clusters of 2–4, terminating the rather few ascending branches: bracts oblanceolate or spatulate, entire above or shallowly toothed, scarious below, viscid-pubescent, ciliate on the margins: hypanthium 8–10 mm. long: sepals triangular-lanceolate, 1 mm. long: petals obovate, 2 mm. long.

Much less branched than *A. congesta* (Nutt.) Rydb.; flower-clusters not so large; bracts and calyx-lobes only half the size.

Summit of Mt. Wilson, *Abrams 2580*, June 30, 1902 (type); along cañons at 1800–2000 meters altitude, San Antonio Mountains, *Hall 1228*, June 18, 1899, in part. Reported from Mt. Wilson by A. Davidson (Bull. So. Calif. Acad. **4**: 40. 1905), under the name *Mentzelia congesta*.

Sphaerostigma pallidum sp. nov.

Annual; stems branching from the base, slender, 1–2 dm. long, sparsely puberulent: leaves canescent with a fine appressed pubescence, the basal ones narrowly oblanceolate, tapering to a long petiole, 4–6 cm. long, 3–4 mm. broad, those of the stem linear-lanceolate, 2–3 cm. long: flowers scattered along the stems from the very base: calyx-lobes silky, 3 mm. long: petals pale-yellow, about 5 mm. long, turning reddish with age: stamens and style about half the length of the petals: capsule slender, attenuate at apex into a short beak, more or less contorted, 2–2.5 cm. long, 1 mm. broad.

This species is of the *S. bistortum* group, but is readily distinguished by its fine appressed pubescence, being not at all hirsute.

Apparently confined to the desert slopes, the following specimens being before me: Palm Springs, *Parish*, April, 1896; Coyote Cañon, *Hall 2791*, April, 1902; Cabazon, *Abrams 3228*, April 6, 1903 (type).

Godetia delicata sp. nov.

Stem erect, slender, simple or branching, 3–6 dm. high: leaves linear, slightly sinuate-toothed, puberulent on the margins, otherwise glabrous, 2–4 cm. long, 3–6 mm. wide: flowers scattered; buds nodding, somewhat obovate when well developed, 8–10 mm. long, these and the sessile hypanthium minutely puberulent: calyx-lobes adherent, turning to one side, not reflexed: petals pink, 15 mm. long, 8 mm. wide at the abruptly rounded apex, tapering to the base, becoming narrow and claw-like below: stamens opposite the petals 9 mm. long, their anthers whitish, 4 mm. long, those alternate with the petals 12 mm. long, their anthers bright-red, 6 mm. long: style slender, 10 mm. long; stigma-lobes broadly obovate, 1.5 mm. long: capsule sessile, linear, quadrate, 2 cm. long, 2 mm. broad, slightly sulcate between the angles at the insertion of the placentae when dry, not at all costate, tapering at the apex into a beak 2–3 mm. long.

This species is nearest *G. epilobioides* (Nutt.) S. Wats., but that has pedicellate capsules, smaller cream-colored obovate petals, and smaller yellowish anthers.

Frequent on shady slopes between Potrero and Campo, San Diego County, *Abrams 3710*, June 3, 1903.

Gilia caruifolia sp. nov.

Annual; stem erect, 3–6 dm. high, paniculate-branched above, the ultimate branches numerous, almost capillary, beset with tack-shaped glands, stem otherwise glabrous: basal leaves pinnate, the pinnae pinnatifid; lobes entire or toothed, apiculate, sparsely viscid-pubescent; lower stem-leaves similar but more reduced, upper becoming small entire lanceolate bracts: pedicels 5–10 mm. long, capillary: flowers solitary: calyx 2 mm. long, white-scarious except the midrib, the teeth scarcely equaling the tube, triangular, very acute: corolla pink; tube slender, 2.5–3 mm. long, slightly exceeding the calyx; limb funnelform; lobes ovate, 2.5 mm. long: filaments inserted about 1 mm. below the sinuses, equaling the corolla-lobes; anthers 0.5 mm. long: style 12 mm. long: capsule oblong, 3–5 mm. long, the seeds about 7 to each cell.

Distinguished from *G. tenuiflora altissima* Parish, with which it has been confused, by its more diffusely branching inflorescence, and short-tubed corolla.

Cuyamaca Mountains, between Cuyamaca Lake and Oriflamme Cañon, *Abrams 3940*, June 28, 1903 (type); Palomar Mountain, altitude 1600 meters, *Chandler 5371*, July 6, 1904.

Diplacus aridus sp. nov.

Low glutinous shrub, 2–4 dm. high, the leaf-bearing branches stramineous, beset with small sessile resinous glands, otherwise glabrous, densely leafy: leaves pale yellowish-green, lanceolate, tapering to a short winged petiole, 2.5–4 cm. long, 7–15 mm. broad, glabrous except for the sessile glands on lower surface, the margins revolute, remotely and obscurely toothed: flowers on pedicels 6 mm. long: calyx 3 cm. long, strongly inflated above, rather abruptly narrowing to a tube 12 mm. long, its teeth unequal, the larger 8 mm. long: corolla pale buff-colored, 4.5–5 cm. long, the long slender tube exceeding the calyx; lobes thickish, those of the upper lip 5 mm. long, 7 mm. broad, shallowly toothed, those of the lower lip 4 mm. long, 5 mm. broad, slightly lobed or entire.

The peculiar calyx and long slender corolla-tube, as well as the pattern of the lobes, readily distinguish this species from all the other members of the genus.

Growing on dry rocky ridges at Jacumba, near the boundary monument, *Abrams 3656*, May 31, 1903.

WYETHIA OVATA T. & G. Emory's Rep. 143. 1848

W. coriacea A. Gray, Proc. Am. Acad. **11**: 77. 1878.

Not *W. ovata* A. Gray, Proc. Am. Acad. **7**: 357. 1868.

Emory's material, according to the label on the type in the Herbarium of Columbia University, was collected on "Dec. 4, 1846." Turning to Emory's notes on page 107 of the work cited above, we find that the expedition of which he was a member left Warner's Ranch on the morning of this date, and pitched camp, "after marching 13½ miles, in the valley of Rio Isabel, near the rancheria of Mr. Stokes, formerly the mission of Saint Isabel." *W. coriacea* was based on specimens collected by Dr. Palmer "on the Mesa Grande, 70 miles north-east of San Diego." As the Mesa Grande lies between Warner's Ranch and San Isabel, and is traversed by the old Fort Yuma and San Diego road, it is clearly evident that the two series of specimens were collected in the same region. And a comparison of the specimens proves them to be identical.

The taking up of this name by Dr. Gray in the Synoptical Flora for his own *W. ovata* of northern California was unquestionably ill-advised.

NEW YORK BOTANICAL GARDEN.

Agropyron tenerum and its allies

CHARLES VANCOUVER PIPER

AGROPYRON TENERUM

Much confusion has prevailed in regard to *Agropyron tenerum* Vasey, and the supposedly different *A. pseudorepens* Scribn. & Smith and *A. Novae-Angliae* Scribn.

The problems surrounding these three supposed species can perhaps best be made clear by a consideration of the type specimens upon which they are based, discussing only such points as have been used in the segregation of the supposed different species and subspecies. All are tall densely cespitose grasses, which only rarely produce stolons.

AGROPYRON TENERUM Vasey, Bot. Gaz. **10**: 258. 1885.

The type of this is from Fort Garland, Colorado, collected by Dr. Geo. Vasey. The specimen is about 90 cm. tall, with rather short, narrow, slightly scabrous, involute leaf-blades, and slender spikes 10–15 cm. long, with small appressed spikelets. The joints of the rachilla are appressed-puberulent. The lowermost sheaths are slightly puberulent.

AGROPYRON TENERUM MAJUS Vasey, Contr. U. S. Nat. Herb. **1**: 280. 1893.

Type from Oregon, probably Union County, *Cusick 1134*, collected in 1884.

This differs from the type of *A. tenerum* only in having flat leaf-blades, scabrous on both sides, 3–6 mm. broad, and somewhat stouter denser spikes 12 cm. long.

AGROPYRON TENERUM LONGIFOLIUM Scribn. & Smith, U. S. Dept. Agr. Div. Agrost. Bull. **4**: 30. 1897.

The type of this is Howell's *no. 256*, collected near Grant's Pass, Oregon, in 1887. It is characterized by rather long, loosely involute, quite smooth leaf-blades, and inordinately loose spikes, 20–25 cm. long. The rachilla is appressed-puberulent. The short awns are better developed than in the types of *A. tenerum* or *A. tenerum majus.*

AGROPYRON TENERUM CILIATUM Scribn. & Smith, U. S. Dept. Agr. Div. Agrost. Bull. **4**: 30. 1897.

The type of this is from Duluth, Minnesota, collected by Dr. Geo. Vasey, August 1, 1880. It is characterized by rather thin and smooth leaf-blades 4–6 mm. broad, and pubescent sheaths.

The rachilla of this type is quite hairy, but it may here be remarked that the character of hairy sheaths is not constantly associated with that of hairy rachilla. Several of the specimens referred to *A. ciliatum* by Scribner & Smith on account of the hairy sheaths have appressed-puberulent rachillae.

The name *ciliatum* is preoccupied in *A. Richardsonii ciliatum* Scribn. & Smith, U. S. Dept. Agr. Div. Agrost. Bull. **4**: 29. 1897.

AGROPYRON PSEUDOREPENS Scribn. & Smith, U. S. Dept. Agr. Div. Agrost. Bull. **4**: 30. 1897.

No type of this species was indicated either in the original publication, or in the herbarium, by its authors. The first cited specimen, and therefore the type, is from Texas, collected by Neally in 1889. This is quite the same as the type of *A. tenerum*, with slightly longer and less involute blades, and a rather loose spike.

The specimen from which the *fig. 592* (U. S. Dept. Agr. Div. Agrost. Bull. **17**:) was drawn, is Rydberg's *2018* from Kearney, Nebraska. This has flat blades, 4–7 mm. broad, and rather stout spikes 10–12 cm. long. The rachilla and the callus of this are hirsute.

Neither of these specimens have rootstocks, nor extra-vaginal innovations, nor, indeed, do any of the specimens cited in the original description.

AGROPYRON PSEUDOREPENS MAGNUM Scribn. & Smith, U. S. Dept. Agr. Div. Agrost. Bull. **4**: 30. 1897.

The type specimen is Rydberg's *2401* from Enterprise, Colorado, collected August 19, 1895. It is characterized by its robust size, 1–1.5 m. high, broad flat leaves, stout spikes and large spikelets. These differences may all be due primarily to vegetative vigor. The rachilla is appressed-puberulent.

AGROPYRON NOVAE-ANGLIAE Scribn. in Jones, Contr. Bot. Vermont **8**: 103. 1903.

Type specimen collected on Willoughby Mountain, Vermont, by Grout & Eggleston, July 2, 1894.

This plant is about 90 cm. high, has flat blades, scabrous on both sides, smooth sheaths, rather slender spikes 10–17 cm. long, and hairy callus and rachilla.

The tall habit and longer leaf-blades are relied upon by the author of the species to distinguish it from *A. violaceum* Lange, and the broad leaves and hairy rachilla from *A. tenerum* Vasey.

It will be noted that the types of two of the above plants, namely *A. tenerum ciliatum* and *A. Novae-Angliae*, have hairy rachillae; the remainder have the rachilla merely puberulent.

Taking these characters which have been pointed out and relied upon as distinctive, the following classification is possible, based partly on general interpretation, partly on types.

Rachilla hairy.	
Sheaths pubescent.	*A. tenerum ciliatum.*
Sheaths smooth.	*A. Novae-Angliae.*
Rachilla scabrous or puberulent.	
Sheaths pubescent.	Unnamed.
Sheaths smooth.	
Leaf-blades narrow or involute; spike slender.	
Spike 10–15 cm. long; leaf-blades rather short.	*A. tenerum.*
Spike 20–25 cm. long; leaf-blades long.	*A. tenerum longifolium.*
Leaf-blades flat, spike a little stouter.	
Stems 30–100 cm. high; blades 12–20 cm. long.	*A. pseudorepens.*
Stems 100–150 cm. high; blades 20–30 cm. long; spike very stout, somewhat one-sided.	*A. pseudorepens magnum.*

Such a classification is quite artificial. The leaf-blade character seems entirely worthless, as all possible intergrades occur in large percentage.

To determine the value of the hairy-rachilla character all the specimens with this peculiarity were selected from among the specimens labelled *A. tenerum* and *A. pseudorepens*, about one-fourth of each being thus distinguished. Comparatively little difficulty was experienced in deciding between appressed-puberulent and hirsute rachillae, but nevertheless puzzling intermediates occur.

The specimens thus selected showed all the variations as to leaf-blades and habit shown by the remainder, and furthermore the two lots were practically coextensive in distribution.

We were quite unable to find any other character associated with a hairy rachilla, and therefore believe it to be wholly illusive as a specific distinction.

The multiplying of names based on varying combinations of these slight characters seems to us undesirable. We would interpret the value of these characters practically by the following arrangement:

A. TENERUM Vasey.
  A. tenerum majus Vasey.
  A. pseudorepens Scribn. & Smith.
  A. Novae-Angliae Scribn.

A. tenerum trichocoleum nom. nov.
  A. tenerum ciliatum Scribn. & Smith.

A. TENERUM LONGIFOLIUM Scribn. & Smith.

A. tenerum magnum (Scribn. & Smith).
  A. pseudorepens magnum Scribn. & Smith.

AGROPYRON BIFLORUM

AGROPYRON BIFLORUM (Brign.) R. & S. Syst. **2**: 760. 1817.
  Triticum biflorum Brign. Fasc. Rar. Pl. Foroj. 18. 1810.
  Triticum violaceum Hornem. Fl. Dan. *pl. 2044*. 1832.
  Agropyron violaceum Lange, Consp. Fl. Groenl. 155. 1880.

Following Ascherson & Graebner (Syn. Fl. Mitteleur.), we take up the above older name for what has usually been called *Agropyron violaceum*. This species is distinguished with some difficulty from *A. tenerum*. The characters of the two species may be thus contrasted:

A. biflorum: Florets 2–5; lower empty glume usually 3-nerved; flowering glume usually broadest above the middle, rather soft in texture; joints of the rachilla usually hairy; spikes dense, seldom exceeding 4 cm. in length; leaf-blades flat, soft, usually short and rather broad; upper sheaths often inflated.

A. tenerum: Florets 3–7; lower empty glume usually 5-nerved; flowering glume usually broadest below the middle, firm in texture; joints of the rachilla usually puberulent; spikes often loose, usually 5–20 cm. long; leaf-blades flat or involute, elongate; upper sheaths not inflated.

None of the above differences is constant, but they serve fairly well to distinguish the species. The material from the Rocky Mountains at rather high elevations is, however, especially puzzling, apparently completely connecting the two species.

We would refer *A. brevifolium* Scribn. to *A. biflorum*.

The two subspecies of *A. biflorum* described by Scribner & Smith are readily distinguishable, and perhaps worthy of specific rank. They are **Agropyron biflorum latiglume** (*A. violaceum latiglume* Scribn. & Smith, U. S. Dept. Agr. Div. Agrost. Bull. **4**: 30. 1897) with the flowering glumes short-pubescent, and **Agropyron biflorum andinum** (*A. violaceum andinum* Scribn. & Smith, *loc. cit.*) with the flowering glumes long-awned.

BUREAU OF PLANT INDUSTRY,
UNITED STATES DEPARTMENT OF AGRICULTURE.

The desmid flora of Nantucket

Joseph Augustine Cushman

The island of Nantucket, from its location some little distance off the coast of Cape Cod, and its many large ponds, seems to be worthy of an investigation in the line of its microscopic flora. It is essentially a sandy soil that characterizes the island, and according to previous work on this group of plants a rich flora was not expected, loose sandy soil usually not being rich in desmids compared to a rocky region. The ponds of the island are open to the sunlight in all their parts, for trees are not a Nantucket characteristic. They are therefore well lighted in the shallow water from which the collections here worked up were taken. For an opportunity to study the contents of these ponds and swamps I have to thank several members of the Nantucket Maria Mitchell Association who very willingly undertook the task of collecting from the various ponds of the island. In all nearly fifty bottles of material were collected, from the last of April to the first week of June being the range of dates. The whole number of species (over fifty) may not seem very large, but many of the forms were very common and well scattered over the island. Certain of the forms are new to the New England flora and such are starred.

Mesotaenium Näg. 1849

M. macrococcum (Kütz.) Roy & Biss. Lat. 18 μ: long. 38 μ. Gibb's Pond.

Cylindrocystis Menegh. 1838

C. Brebissonii Menegh. Long. 50 μ: lat. 18 μ. Tom Never's Pond.

C. Brebissoni minor W. & G. S. West. Long. 32 μ: lat. 12 μ. Great Miox's Pond.

Netrium Näg. 1849

N. Digitus (Ehrenb.) Itzigs. & Rothe. Long. 99–186 μ: lat. med. 34–65 μ: apex 14–21 μ. Gibb's Pond, Wigwam Pond, Almanac Pond.

PENIUM Bréb. 1844

* P. PHYMATOSPORUM Nordst. Long. 35–40 μ: lat. 15.5–16.5 μ: lat. isthm. 13.5 μ. Tom Never's Pond, pond near Old North Cemetery.

CLOSTERIUM Nitzsch. 1817

C. COSTATUM Corda. Long. 280 μ: lat. 26 μ: apex 9 μ. Almanac Pond. Small.

C. STRIOLATUM Ehrenb. Long. 200–450 μ: lat. 18–32 μ: apex 10 μ. Bog pond near Old North Cemetery; also Almanac, Pest House and Squam Ponds.

C. INCURVUM Bréb. Long. 62 μ: lat. 11 μ. Gibb's and Almanac Ponds.

C. VENUS Kütz. Long. 80 μ: lat. 10 μ. Wigwam, Pest House and Squam Ponds.

C. LEIBLEINII Kütz. Long. 112–190 μ: lat. 19–34 μ: apex 3.5–5 μ. Hummock and Copaum Ponds.

C. MONILIFERUM (Bory) Ehrenb. Long. 225 μ: lat. 46 μ. Pest House Pond.

C. ACEROSUM ELONGATUM Bréb. Long. 500 μ: lat. 37 μ: apex 5 μ. Lily Pond Ditch.

* C. LUNULA INTERMEDIUM Gutw. Long. 440 μ: lat. 65 μ: apex 12 μ. Gibb's Pond.

C. ABRUPTUM West. Long. 200 μ: lat. 15.5 μ: apex 6 μ. Gibb's Pond.

C. DECORUM Bréb. Long. 375 μ: lat. 25 μ: apex 8.5 μ. Gibb's Pond.

C. SETACEUM Ehrenb. Long. 235 μ: lat. 6 μ. Almanac Pond.

PLEUROTAENIUM Näg. 1849

P. EHRENBERGII (Bréb.) DeBary. Long. 38 μ: lat. bas. 25 μ: apex 20 μ. Wigwam and Almanac Ponds.

P. TRABECULA (Ehrenb.) Näg. Long. 400 μ: lat. 37 μ: apex 24 μ. Gibb's Pond.

TETMEMORUS Ralfs. 1844

T. GRANULATUS (Bréb.) Ralfs. Long. 146 μ: lat. 34 μ. Wigwam and Almanac Ponds.

T. LAEVIS (Kütz.) Ralfs. Long. 70–90 μ: lat. 21–22 μ. Lily Pond Ditch; Copaum and Tom Never's Ponds.

EUASTRUM Ehrenb. 1832

E. DIDELTA (Turp.) Ralfs. Long. 125 μ: lat. 65 μ: lat. lob. pol. 26 μ: isthm. 18 μ. Gibb's Pond.

E. AFFINE Ralfs. Long. 112 μ: lat. 68 μ: lob. pol. 28 μ: isthm. 19 μ. Wigwam Pond.

E. PINNATUM Ralfs. Long. 100 μ. Wigwam Pond.

E. ABRUPTUM forma MINOR W. & G. S. West. Long. 25–33 μ: lat. 22 μ: lob. pol. 14 μ: crass. 14 μ: isthm. 4.5 μ. Gibb's and Wigwam Ponds.

E. OBLONGUM (Grev.) Ralfs. Long. 160–170 μ: lat. 72–84 μ: lob. pol. 45–47 μ: isthm. 20–23 μ. Hummock Pond and pond near Old North Cemetery.

E. BINALE Ehrenb. Long. 19 μ: lat. 15.5 μ: lob. pol. 13 μ: isthm. 3.8 μ. Wigwam and Tom Never's Ponds.

* E. FISSUM W. & G. S. West, forma. Long. 40 μ: lat. 33 μ: isthm. 6 μ. Wigwam Pond.

E. ELEGANS (Bréb.) Kütz. Long. 43–48 μ: lat. 30–32 μ; lob. pol. 24–25 μ: isthm. 8 μ. Gibb's and Tom Never's Ponds; also pond near Old North Cemetery.

MICRASTERIAS Ag. 1827

M. TRUNCATA (Corda) Bréb. Long. 95 μ: lat. 87 μ: lob. pol. 65 μ: isthm. 22 μ. Squam Pond.

M. AMERICANA RECTA Wolle. Long. 115 μ: lat. 90 μ: lob. pol. 56 μ: isthm. 28 μ. Pond near Old North Cemetery.

COSMARIUM Corda. 1834

C. ORNATUM Ralfs. Long. 34–48 μ: lat. 34–36 μ: isthm. 11–12 μ. Wigwam and Copaum Ponds.

C. AMOENUM Bréb. Long. 47 μ: lat. 25 μ. Wigwam and Almanac Ponds.

C. TAXICHONDRUM Lund. Long. 44 μ: lat. 42 μ: isthm. 12.5 μ. Wigwam Pond.

C. CONNATUM Bréb. Long. 59 μ: lat. 43 μ: isthm. 40 μ. Almanac Pond.

* C. PHASEOLUM forma ELEVATUM Nordst. Long. 32 μ: lat. 25 μ: isthm. 8 μ. Great Miox's Pond.

C. PYRAMIDATUM Bréb. Long. 78–100 μ: lat. 50–62 μ: isthm.

15–16 μ. Bog pond near Old North Cemetery; Copaum and Tom Never's Ponds.

* C. BIREMUM Nordst. Long. 13 μ; lat. 12 μ. Wigwam and Tom Never's Ponds.

C. INTERMEDIUM Delp. Long. 48 μ: lat. 42 μ: isthm. 14 μ. Reedy Pond.

* C. EXIGUUM Arch. Long. 23–24 μ: lat. 13 μ: isthm. 3–3.5 μ. Copaum Pond; also pond near Old North Cemetery.

* C. GRANATUM SUBGRANATUM Nordst. Long. 21–23 μ: lat. 16–17 μ: isthm. 3.5–4.5 μ. Copaum, Great Miox's and Reedy Ponds.

C. MENEGHINII Bréb. Long. 19 μ: lat. 15 μ: isthm. 4 μ. Great Miox's Pond.

XANTHIDIUM Ehrenb. 1834

X. ANTILOPAEUM (Bréb.) Kütz. Long. c. spin. 71 μ: s. sp. 46 μ: lat. c. sp. 71 μ: s. sp. 46 μ: isthm. 14 μ. Almanac Pond.

ARTHRODESMUS Ehrenb. 1838

A. OCTOCORNIS Ehrenb. Long. c. sp. 25 μ: s. sp. 14 μ: lat. c. sp. 22 μ: s. sp. 14.5 μ: isthm. 4 μ. Almanac and Pest House Ponds.

A. INCUS (Bréb.) Kütz. Long. s. sp. 25 μ: lat. c. sp. 84 μ: s. sp. 22 μ: isthm. 7 μ. Tom Never's Pond.

STAURASTRUM Meyen. 1829

S. MACROCERUM Wolle. Long. 46 μ: lat. c. proc. 86 μ: s. proc. 22 μ. Wigwam Pond.

S. STRIOLATUM Näg. Lat. 28 μ. Wigwam Pond.

* S. DISTENTUM Wolle. Lat. c. proc. 34 μ. Pest House Pond.

S. LEWISII Wood. Long. c. sp. 38 μ: s. sp. 19 μ: lat. c. sp. 34 μ: s. sp. 15.5 μ: isthm. 4 μ. Almanac and Wigwam Ponds.

S. PYGMAEUM Bréb. Long. 35 μ: lat. 31 μ: isthm. 10 μ. Gibb's Pond.

S. RAVENELII Wood. Lat. c. sp. 50 μ: s. sp. 45 μ: isthm. 14 μ. Great Miox's and Pest House Ponds.

SPHAEROZOSMA Corda. 1835

S. EXCAVATUM Ralfs. Long. cell. 7.5 μ: lat. 7 μ: isthm. 3.5 μ. Wigwam Pond.

ONYCHONEMA Wallich. 1860

* O. SERRATUM (Bail.) Stokes. Long. c. proc. 24 μ: s. proc. 15.5 μ: lat. c. proc. 25 μ: s. proc. 19 μ: isthm. 3.5 μ. Wigwam Pond.

DESMIDIUM Ag. 1824

D. SWARTZII Ag. Lat. filament 37 μ. Wigwam Pond.

GYMNOZYGA Ehrenb. 1840

G. MONILIFORMIS Ehrenb. Lat. filament 27 μ. Wigwam Pond.

BOSTON SOCIETY OF NATURAL HISTORY.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Anderson, J. P. Plants new to the flora of Decatur County, Iowa. Proc. Iowa Acad. Sci. **12**: 133–138. 1905.

Andrews, A. L. Additions to the bryophytic flora of West Virginia. Bryologist **8**: 63–65. 15 Jl 1905.

Arthur, J. C. Rusts on *Compositae* from Mexico. Bot. Gaz. **40**: 196–208. 15 S 1905.

With descriptions of new species in *Coleosporium* (2), *Dietelia* (2), *Uromyces*, and *Puccinia* (13).

Bailey, W. W. Stirrings of life. Am. Bot. **8**: 49–51. [Ap] 1905.

Ballard, S. J. A second Vermont station for *Arenaria macrophylla*. Rhodora **7**: 156. 5 Au 1905.

Bessey, C. E. How much plant pathology ought a teacher of botany to know? Plant World **8**: 189–197. [S] 1905.

Billings, F. H. Precursory leaf-serrations of *Ulmus americana*. Bot. Gaz. **40**: 224, 225. *f. 1, 2.* 15 S 1905.

Blakeslee, A. F. Two conidia-bearing fungi. *Cunninghamella* and *Thamnocephalis* n. gen. Bot. Gaz. **40**: 161–170. *pl 6.* 15 S 1905.

Blanchard, W. H. The yellow-fruited variety of the black raspberry. Rhodora **7**: 143–146. 5 Au 1905.

Blodgett, F. H. Fasciation in field peas. Plant World **8**: 170–177. *f. 35–38.* [Au] 1905.

Borgeson, F. & Jónsson, H. The distribution of the marine algae of the arctic sea and of the northernmost part of the Atlantic. Botany of the Faeröes, Appendix, i–xxviii. [Copenhagen, 1905.]

Bolley, H. L. & Pritchard, F. J. Internal infection of the wheat grain by rust — a new observation. Science II. **22**: 343, 344. 15 S 1905.

Brandegee, T. S. A new *Calamintha*. Zoe **5**: 195. 19 Au 1905.

C. Chandleri sp. nov., from southern California.

Brandegee, T. S. Plants from Sinaloa, Mexico. Zoe **5**: 196–210. 19 Au 1905; 211–226. 29 Au 1905.

With descriptions of 54 new species in 43 genera.

Bray, W. L. Vegetation of the sotol country in Texas. Bull. Univ. Texas 60: 1–24. *pl. 1–11.* 15 Je 1905.

Britton, E G. A long lost genus to the United States — *Erpodium* (Brid.) M. C. Bryologist **8**: 71. 15 Jl 1905.

Britton, N. L. A lost species of *Begonia* apparently rediscovered. Jour. N. Y. Bot. Gard. **6**: 146–148. *f. 33.* S 1905.

B. rotundifolia Lam.

Chittenden, A. K. Forest conditions of northern New Hampshire. U. S Dept. Agric. Forestry Bull. **55**: 1–100. *pl. 1–7 + map.* 1905.

Chittenden, A. K. The red gum. U. S. Dept. Agric. Forestry Bull. **58**: 1–39. *pl. 1–6 + map.* 1905.

Clark, N. Cotyledon- and leaf-structure in certain *Ranunculaceae*. Torreya **5**: 164–166. *f. 1–8.* 23 S 1905.

Clute, W. N. The chantarelle. (*Cantharellus cibarius.*) Am. Bot. **7**: 101, 102, *pl.* [F 1905.]

Clute, W. N. The common clematis. (*Clematis virginiana.*) Am. Bot. **8**: 21, 22. *pl.* [Mr] 1905.

Clute, W. N. The Forest of Arden [Joliet, Ill.] Am. Bot. **8**: 1–4. [F] 1905.

Clute, W. N. The partridge pea. Am. Bot. **8**: 30–32. Au 1905. [Illust.]

Clute, W. N. Species and varieties among the ferns. Fern. Bull. **13**: 65–74. [S] 1905.

Clute, W. N. A walking shield-fern. *Polystichum Plaschnickianum.* Fern Bull. **13**: 78, 79. [S] 1905. [Illust.]

Colgate, E. J. The *Orchidaceae* of Wellington County [Ontario]. Ont. Nat. Sci. Bull. **1**: 32. 15 Ap 1905.

Cook, O. F. & Swingle, W. T. Evolution of cellular structures. U. S. Dept. Agric. Plant Ind. Bull. **81**: 1–26. *pl. 1 + f. 1, 2.* 4 Au 1905.

Cufino, L. Osservazioni ed aggiunte alla flora del Canadà. Malpighia **19**: 187–196. 1905.

A partial list of plants collected by A. Hill in British Columbia.

Davis, B. M. Studies on the plant cell — VI. Am. Nat. **39**: 449–499. 13 Jl 1905; — VII. Am. Nat. **39**: 555–599. 19 Au 1905.

Dearness, J. The *Orchidaceae* of Middlesex County [Ontario]. Ont. Nat. Sci. Bull. **1**: 33, 34. 15 Ap 1905.

Dobbin, F. A sphagnum bog. Am. Bot. **8**: 51–53. [Ap] 1905.

Duvel, J. W. T. The vitality of buried seeds. U. S. Dept. Agric. Plant Ind. Bull **83**: 1–22. *pl. 1–3.* 4 Au 1905.

Eaton, A. A. *Botrychium biternatum* Underw. Fern Bull. **13**: 87. [S] 1905.

Edwards, A. M. *Bacillaria* (diatoms) of the United States Geological Survey of the Territories. Nuova Notar. **16**: 81–84. Jl 1905.

Edwards, A. M. *Trochiscia moniliformis* a form of *Bacillaria*. Nuova Notar. **16**: 54–58. Ap 1905.

Evans, A. W. Diagnostic characters in the *Jungermanniaceae*. Bryologist **8**: 57–63. *pl. 5.* 15 Jl 1905.

Fawcett, H. S. Variation in ray flowers of *Anthemis Cotula* and other composites. Proc. Iowa Acad. Sci. **12**: 55–67. *pl. 12.* 1905.

Fernald, M. L. *Anaphalis margaritacea* var. *occidentalis* in eastern America. Rhodora **7**: 156. 5 Au 1905.

Fernald, M. L. The genus *Arnica* in northeastern America. Rhodora **7**: 146–150. 5 Au 1905.

Seven species are recognized, of which 3 are described as new.

Fernald, M. L. Some lithological variations of *Ribes*. Rhodora **7**: 153–156. 5 Au 1905.

Fernald, M. L. *Spergula sativa* in Connecticut. Rhodora **7**: 151–153. 5 Au 1905.

Fink, B. Notes on American cladonias. Proc. Iowa Acad. Sci. **12**: 15–20. *pl. 6, 7.* 1905.

Fink, B. Some notes on certain Iowa algae. Proc. Iowa Acad. Sci. **12**: 21–27. 1905.

Gifford, J. C. The Luquillo Forest Reserve, Porto Rico. U. S. Dept. Agric. Forestry Bull. **54**: 1–52. *pl. 1–8 + map.* 1905.

Gilbert, B. D. Observations on North American pteridophytes. Fern Bull. **13**: 74–77. [S] 1905.

Gilbert, B. D. Some Mexican fernworts. Fern Bull. **13**: 79–83. [S] 1905.

Gow, J. E. An ecological study of the Sabine and Neches valleys, Texas. Proc. Iowa Acad. Sci. **12**: 39–47. *pl. 9–11.* 1905.

Greene, E. L. Extension of *Osmaronia.* Pittonia **5**: 309–312. 9 S 1905.

With descriptions of 5 new species.

Greene, E. L. Latin as the language of botanical diagnosis. Science II. **22**: 338–340. 15 S 1905.

Greene, E. L. Origin of *Rhus bipinnata.* Torreya **5**: 155–157. 23 S 1905.

Harper, R. M. Phytogeographical explorations in the coastal plain of Georgia in 1904. Bull. Torrey Club **32**: 451–467. *f. 1–5.* 21 S 1905.

Harper, R. M. Some large specimens of small trees in Georgia. Torreya **5**: 162–164. *f. 1.* 23 S 1905.

Harris, J. A. New fasciations. Torreya **5**: 157–160. 23 S 1905.

Harter, L. L. The variability of wheat varieties in resistance to toxic salts. U. S. Dept. Agric. Plant Ind. Bull. **79**: 1–48. 27 Jl 1905.

Hay, G. U. The study of Canadian fungi: a review. Trans. Roy. Soc. Canada II. **10**[4]: 139–145. 1905.

Herriot, W. Some new or little known Canadian plants. Ont. Nat. Sci. Bull. **1**: 26–30. 15 Ap 1905.

Hitchcock, A. S. North American species of *Agrostis.* U. S. Dept. Agric. Plant Ind. Bull. **68**: 1–68. *pl. 1–37 + f. 1, 2.* 29 Ap 1905.

Twenty-seven species are recognized, of which three are described as new.

Holm, T. "New species" of plants. Ont. Nat. Sci. Bull. **1**: 34–36. 15 Ap 1905.

House, H. D. *Lespedeza velutina* Bicknell a homonym. Torreya **5**: 167. 23 S 1905.

Jarvis, T. D. The *Gramineae* of the vicinity of Guelph [Ontario]. Ont. Nat. Sci. Bull. **1**: 37, 38. 15 Ap 1905.

Kirby, J. Some plants of Hempstead Plains [Long Island, N. Y.]. Am. Bot. **7**: 110. [F 1905.]

Klugh, A. B. The genus *Aster* at Puslinch Lake. Ont. Nat. Sci. Bull. **1**: 30, 31. 15 Ap 1905.

Klugh, A. B. The horsetails and club-mosses of Wellington County, Ontario. Am. Bot. **8**: 4–6. [F] 1905.

Klugh, A. B. The local distribution of plants. Am. Bot. **7**: 115, 116. [F 1905.]

Klugh, A. B. *Nephrodium Boottii* or *Nephrodium spinulosum* × *cristatum*. Fern Bull. **13**: 86. [S] 1905.

Laughlin, E. E. Harbinger of Spring. Am. Bot. **8**: 6, 7. [F] 1905.

Lawrence, W. H. The *Erysiphaceae* of Washington. 1–8. *f. 1–22.* Pullman, Wash., Ap 1905.

Lindly, J. M. Flowering plants of Henry County [Iowa]. Proc. Iowa Acad. Sci. **12**: 157–164. 1905.

Livingston, B. E. Relation of transpiration to growth in wheat. Bot. Gaz. **40**: 178–195. *f. 1–21.* 15 S 1905.

Lovell, J. H. The colors of northern flowers. Am. Bot. **8**: 41–47. [Ap] 1905.

Macbride, T. H. The slime moulds of New Mexico. Proc. Iowa Acad. Sci. **12**: 33–38. 1905.

MacDougal, D. T. Suwarro or saguaro. Jour. N. Y. Bot. Gard. **6**: 149, 150. S 1905.

MacKay, A. H. Bibliography of Canadian botany for 1903. Trans. Roy. Soc. Canada II. **10**[4]: 153–160. 1905.

Mackenzie, K. K. *Onosmodium.* Bull. Torrey Club **32**: 495–506. 21 S 1905.

Seven species and three varieties are recognized.

Macloskie, G. Flora patagonica; flowering plants (continued). Rep. Princeton Univ. Exped. Patagonia **8**: 339–594. *pl. 15–20* + *f. 62–76.* 2 Ja 1905.

Martin, J. S. A few Maine blossoms. Am. Bot. **8**: 7–9. [F] 1905.

Mottier, D. M. The development of the heterotypic chromosomes in pollen mother-cells. Bot. Gaz. **40**: 171–177. 15 S 1905.

Murrill, W. A. The *Polyporaceae* of North America — XII. A synopsis of the white and bright-colored pileate species. Bull. Torrey Club **32**: 469–493. 21 S 1905.

With descriptions of 13 new genera and one new species.

Nicholson, W. E. *Tortula pagorum* (Milde) DeNot. Bryologist **8**: 70. 15 Jl 1905.

Niles, G. G. Hoosac Valley and its flowers and ferns. Am. Bot. **9**: 21–28. Au 1905. [Illust.]

Pammel, L. H. Notes on the flora, especially the forest flora, of the Bitter Root mountains [Montana]. Proc. Iowa Acad. Sci. **12**: 87–100. *pl. 22–27.* 1905.

Peck, M. E. The flowering plants of Hardin County [Iowa]. Proc. Iowa Acad. Sci. **12**: 193–241. 1905.

Piper, C. V. Grass lands of the south Alaska coast. U. S. Dept. Agric. Plant Ind. Bull. **82**: 1–38. *pl. 1–4.* 22 Au 1905.

Pond, R. H. The biological relation of aquatic plants to the substratum. Rep. U. S. Comm. Fish and Fisheries **1903**: 483–526. *f. 1–6.* 1905.

Ramaley, F. A botanist's trip to Java. Plant World **8**: 139–150. *f. 31–34.* [Jl] 1905.

Reed, H. S. A brief history of ecological work in botany Plant World **8**: 163–170. [Au] 1905; 198–208. [S] 1905.

Rolfe, R. A. *Odontoglossum ramulosum.* Curt. Bot. Mag. IV. **1**: *pl. 8031.* 1 Au 1905.
Native of Colombia.

Sargent, F. L. Lichenology for beginners — II. Bryologist **8**: 66–69. *f. 1–6.* 15 Jl 1905.

Scofield, C. S. The salt water limits of wild rice. U. S. Dept. Agric. Plant Ind. Bull. **72**[2]: 1–8. 25 Ja 1905.

Seaver, F. J. An annotated list of Iowa *Discomycetes.* Proc. Iowa Acad. Sci. **12**: 105–120. 1905.

Sempers, J. F. Fringed gentian notes. Am. Bot. **8**: 30–32. [Mr] 1905.

Setchell, W. A. Parasitic *Florideae* of California. Nuova Notar. **16**: 59–63. Ap 1905.
Includes a description of *Peysonellopsis* Setchell & Lawson, gen. nov.

Shattuck, C. H. A morphological study of *Ulmus americana.* Bot. Gaz. **40**: 209–223. *pl. 7–9.* 15 S 1905.

Shear, C. L. Letter of Dr. Asa Gray to Lewis D. de Schweinitz. Rhodora **7**: 141–143. 5 Au 1905.

Sheldon, J. L. The effect of different soils on the development of the carnation rust. Bot. Gaz. **40**: 225–229. 15 S 1905.

Shimek, B. Botany in its relation to good citizenship. Proc. Iowa Acad. Sci. **12**: 1–6. 1905.

Skeels, H. C. A weed study. Am. Bot. **8**: 26–29. [Mr] 1905.

Squires, W. A. The earliest spring blossoms. Am. Bot. **8**: 47–49. [Ap] 1905.

Squires, W. A. The greenish-fringed rein orchis. Am. Bot. **8**: 29, 30. [Mr] 1905.

Terry, E. H. More about the ferns of Dorset. Fern Bull. **13**: 84, 85. [S] 1905.

Tidestrom, I. Note on *Botrychium virginianum* (L.) Sw. Torreya **5**: 162. *f. 1.* 23 S 1905.

Townsend, C. O. & Rittue, E. C. The development of single-germ beet seed. U. S. Dept. Agric. Plant Ind. Bull. **73**: 1–26. *pl. 1–8* + *f. 1–6.* 25 Mr 1905.

Webber, H. J. & Swingle, W. T. New citrus creations of the Department of Agriculture. Yearbook U. S. Dept. Agric. **1904**: 221–240. *pl. 10–22.* 1905.

Wheeler, L. A. The orchids of Stony Park. Am. Bot. **7**: 102–106. [F 1905.]

White, C. A. The mutations of *Lycopersicum.* Pop. Sci. Mo. **67**: 151–161. *f. 1, 2.* Je 1905.

White, C. A. The relation of phylogenesis to historical geology. Science II. **22**: 105–113. 28 Jl 1905.

White, C. H. Autophytography: a process of plant fossilization. Am. Jour. Sci. IV. **19**: 231–236. *f. 1–5.* Mr 1905.

White, E. A. A preliminary report on the *Hymeniales* of Connecticut. Conn. Geol. & Nat. Hist. Surv. Bull. **3**: 1–81. *pl. 1–40.* 1905.

White, J. The *Orchidaceae* of Peel County [Ontario]. Ont. Nat. Sci. Bull. **1**: 31, 32. 15 Ap 1905.

Wildeman, E. de. *Cassia corymbosa* Lam. Ic. Sel. Hort. Thenensis **5**: *pl. 183.* Ap 1905.
Native of temperate South America.

Wildeman, E. de. *Flueckigera roseo-aenea* DeWild. Ic. Sel. Hort. Thenensis **5**: *pl. 179.* Ja 1905.
Native of Brazil.

Wildeman, E. de. *Scaphyglottis Cogniauxiana* De Wildeman, nov. sp. Gard. Chron. III. **37**: 33, 34. 21 Ja 1905.
Native of Brazil.

Wildeman, E. de. *Townsendia Wilcoxiana* Wood. Ic. Sel. Hort. Thenensis **5**: *pl. 185.* Ap 1905.

Wittmack, L. Our present knowledge of ancient plants. Trans. Acad. Sci. St. Louis **15**: 1–15. 25 F 1905.

Woods, A. F. The relation of plant physiology to the development of agriculture. Yearbook U. S. Dept. Agric. **1904**: 119–132. 1905.

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BULLETIN

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NOVEMBER, 1905

Phycological studies — II. New Chlorophyceae, new Rhodophyceae, and miscellaneous notes *

Marshall Avery Howe

(With plates 23–29)

A. NEW CHLOROPHYCEAE

Halimeda favulosa sp. nov.

Of a light bright-green when living, often albescent or yellowish on drying, rather flaccid, suberect or more commonly decumbent (especially if uncovered at low tide), somewhat easily friable when dry, the surface then strongly favulose even to the naked eye and with a subcrystalline lustre; plants reaching a height or length of 9–22 cm., usually of congested habit, the numerous branches mostly originating near the very short, flattened stipe, this consisting of 1–4 more or less fused segments: rhizoids forming a bulbous mass with the adherent granules of sand: segments variable in form, ranging, without apparent order, from discoid and often trilobed to cylindrical and entire in different parts of a single individual, 4–9 mm. long, 2–9 mm. broad, 0.5–2 mm. thick: peripheral utricles turbinate, subcrateriform, obovoid, or pestle-shaped, 150–400 μ long, 110–260 μ in diameter in surface view, supported and separated by calcareous calyces, the exposed rounded-obtuse or truncate apical portion strongly collapsed on drying, even the whole utricle often withdrawing from the calcareous lateral walls and shriveling to the bottom of the cup; utricles free on decalcification or but slightly and irregularly coherent; subcortical layer thin, the central filaments easily visible through the cortex after removal of the lime: filaments of the central strand coherent at the nodes, being there closely connected by

* Investigation aided by a grant from the John Strong Newberry Fund of the Council of the Scientific Alliance of New York.

[The Bulletin for October (32: 515–561) was issued 21 O 1905.]

very short anastomosing processes. [PLATE 23, FIGURE 2; PLATE 24; PLATE 26, FIGURES 1–6.]

Near low-water mark in the Bahama Islands: *no. 3981*, type (Cave Cays, Exuma Chain, 19 February 1905, M. A. H.); *nos. 3417b* and *3421b* (Rose Island); *no. 4186a* (Stocking Island, Exuma Harbor).

Halimeda favulosa simulates in form, size and habit certain conditions of *H. tridens* (Ell. & Soland.) Lamour. or of *H. tridens Monile* (Ell. & Soland.) * but is easily and constantly distinguished by the very large peripheral utricles (110–260 μ *vs.* 33–68 μ in *H. tridens*) which, on drying, collapse or withdraw into the subtending and separating lime-cups, leaving the surface conspicuously and rather beautifully favulose. In the character of the peripheral utricles the species suggests *H. macrophysa* Ask., though its utricles are sometimes even larger than in that, according to the measurements given by Askenasy and by Barton, but it has the size, form, and node-characters of the *H. tridens* group instead of the *H. Tuna-H. macrophysa* alliance. It evidently bears a relation to *H. tridens* similar to that of *H. macrophysa* to *H. Tuna*. In case of three out of the four collection numbers cited above, *H. favulosa* was found growing in company with *H. tridens* or *H. tridens Monile* and resembling them so much in habit that the distinctive characters escaped observation at the time of gathering.

There is a possibility that *Halimeda favulosa* will prove to be *H. brevicaulis* Kütz., † described from the Bahamas, but the doubts in regard to this can probably never be resolved unless Kützing's specimen, which now seems to be lost, is found.‡ *H. brevicaulis*, according to Kützing's figure and brief description, might equally well be a form of the extremely variable *H. tridens*, which is more abundant in the same region. The short stipe of "*brevicaulis*" has no special significance, but the apparently flaccid habit and tapering branches, it must be admitted, are rather suggestive of *H. favulosa*. Yet flaccid, decumbent conditions of *H. tridens* occur. Kützing describes the stipe of *H. brevicaulis* as terete, while in all the specimens of *H. favulosa* that we have

---

* **Halimeda tridens Monile** (Ell. & Soland.)

Corallina Monile Ell. & Soland. Nat. Hist. Zooph. 110. *pl. 20. f. c.* 1786.

† Tab. Phyc. **8**: 11. *pl. 25. f. 2.* 1858.

‡ See "Addendum" on page 586.

seen it is much flattened and in all the branching is much more congested. Furthermore, it seems hardly probable that Kützing, doubtless studying a dried specimen, would have failed to notice the peculiar and striking favulosity of the surface if he had had before him the species described above. Kützing's figure of *Halimeda Monile* (*l. c. pl. 26. f. 1*) illustrates the habit of the moniliform condition of *H. favulosa* rather well.

Hauck (Hedwigia **25**: 168. 1886) has gone on record as having seen an authentic specimen of *H. brevicaulis*,* but neither in the herbarium of Hauck nor that of Kützing, both now owned by Mme. Weber-van Bosse, is such a specimen to be found. The species is unrepresented also in a set of cotypes sent by Kützing to Montagne and now preserved in the Muséum d'Histoire Naturelle at Paris.

The Ellis and Solander types of *Halimeda* are said also to have disappeared † but none of their figures and descriptions of West Indian forms is especially suggestive of *H. favulosa;* at least, such an application is not likely to be proved in absence of original specimens.

In *Halimeda favulosa*, the peripheral utricles and sometimes the filaments of the subcortical layer and of the central strand are now and then gorged with dense granular contents as shown in our FIGURE 4. We have found no evidence that such parts become detached, but for some reason a reserve food supply seems to be concentrated in them.

Avrainvillea levis sp. nov.

Olivaceous when living, on drying often slightly tinged with yellow or verging toward cinereous, or at the margins sometimes fuscous, caespitose or gregarious from a short, scarcely rhizomatous base; stipe 0.5–4 cm. long, flattened or subcylindrical, simple or occasionally dichotomous at base: flabellum varying from reniform-suborbicular with cordate base to cuneiform-obovate, 1–7 cm. broad, entire, erose, or sometimes lobed, thin and membranous or sometimes thicker and coriaceous, compact in texture with a smooth or slightly wrinkled surface, for the most part distinctly zonate, now and then tending to form serially superposed flabella at the margins of the zones: filaments of flabellum slender, tortuous, interwoven, usually lightly and irregularly torulose, rarely

* Printed "*multicaulis*" by Hauck through an evident *lapsus*, as shown by label on Comoro specimen cited.

† Barton, E. S. The Genus *Halimeda*. Siboga-Expeditie, Monographe **60**: 1, 2. 1901.

somewhat moniliform, mostly 6–24 μ in diameter; those of interior often a little larger (reaching 35 μ), more chlorophyllose and less tortuous: angle of dichotomy commonly acute (about 30°–45°), sometimes obtuse (reaching 120°). [PLATE 23, FIGURE 1; PLATE 23, FIGURES 8–10.]

In the Bahama Islands, near low-water mark, or when growing under a rock overhang sometimes exposed at low tide: *no. 3996*, type (Cave Cays, Exuma Chain, 19 February 1905, M.A.H.); *no. 3574* (Frozen Cay, Berry Islands); *no. 3966* (Shroud's Cay, Exuma Chain).

The above-described species, though here appearing under a new specific name attached to a new nomenclatorial type, is doubtless the same as the species described by Murray and Boodle (Jour. Bot. **27**: 70. 1889) under the designation "*A. sordida* Crn. excl. syn." But according to both the Philadelphia and the Vienna codes of nomenclature, the use of the name *Avrainvillea sordida* for this species cannot be justified unless perchance it can be shown to be identical with the species described from the Philippines by Montagne in 1844 as *Udotea sordida*. The combination "*A. sordida* (Mont.) Crn. mscr." apparently first appeared in print in Mazé and Schramm's Essai de Classification des Algues de la Guadeloupe (p. 89. 1870–'77) and is there based on quoted synonymy, the citation of Guadeloupe specimens under collection numbers, and the following description: "De couleur brune olivâtre à l'état de vie." Under these circumstances, when one excludes synonymy one excludes all that has technical value in publication, and the name *Avrainvillea sordida* Crn., if used at all, must be made to apply to Montagne's plant. Our species, if it is to be kept separate from its Eastern Hemisphere analogue, as at present we believe it should, deserves a distinctive name.

Avrainvillea levis has a smooth compact surface that suggests a *Udotea* at first sight, though its structure is clearly that of an *Avrainvillea*. The filaments of the flabellum, however, are not so uniform in character as is the case in the other West Indian species of the genus, the filaments of the surface being often more slender, more tortuous, and less chlorophyllose than those of the interior.

Avrainvillea levis, so far as our experience goes, is the most constant and most easily recognized of the West Indian forms of this puzzling genus. Our remaining specimens, representing at the present time about thirty localities, can be arranged, though rather unsatisfactorily, in two groups, which for the present we are designating as *Avrainvillea nigricans* Decaisne and *A. Mazei* Murray & Boodle. *Avrainvillea longicaulis*, as described and figured by Murray and Boodle,* we are convinced cannot be considered specifically different from *A. nigricans*, as represented by the probable type of the latter species preserved in the herbarium of the Muséum d'Histoire Naturelle in Paris.

The type of *Avrainvillea nigricans* Decaisne is referred to in the following words in the place of original description: † "In Antillis (îles des Saintes propè la Guadeloupe). — Cl. d'Avrainville. (v. in Herb. Mus. Paris.)." In the herbarium of the Paris museum, there is at the present time no specimen of d'Avrainville's collecting bearing the name *Avrainvillea nigricans*, but there is a single specimen associated with a label inscribed in Decaisne's hand: "*Avrainvillea nigra* Dne. Iles des Saintes près la Guadeloupe. M. D'Avrainville. 1842," and as this agrees with the description published under the specific name *nigricans*, there can be no reasonable doubt that it is the true type of the species in question. This specimen has a single somewhat worn and broken flabellum supported by a stipe a trifle more than 1 cm. long springing from a subcylindrical rhizome 3.5 cm. long, which is continued beyond into what may have been the stipe of another flabellum; the flabellum proper has a length of 3.3 cm. and its original width was probably about the same; the filaments of the flabellum are moniliform, as originally described, and have a diameter of 44–55 μ. We can discover nothing beyond its smaller size to distinguish it from the *A. longicaulis* of Murray and Boodle. The original *Rhipilia longicaulis* of Kützing ‡ "Ad Antillas (Herb. Sonder)" has not been found in the Kützing herbarium now owned by Madame Weber-van Bosse, and an inquiry in regard to it has been addressed to Melbourne, Australia, where the Sonder herbarium, cited by Kützing, is supposed to be.§ The plant needs further study. We have never seen filaments from a flabellum ending in slender hyaline hairs like those figured and described by Kützing.

* Jour. Bot. **27**: 70. *pl. 288. f. 1–5.* 1889.

† Ann. Sci. Nat. II. **18**: 108. 1842.

‡ Kütz. Tab. Phyc. **8**: 13. *pl. 28. f. 2.* 1858.

§ See "Addendum" on page 586.

Rhizoidal filaments often have such a character but Kützing states that the figured filament came "aus dem Phyllom."

Avrainvillea nigricans and *A. Mazei*, as we interpret them, are best distinguished by the character of the filaments of the flabellum, those of *A. nigricans* being moniliform and those of *A. Mazei* being cylindrical with an abrupt constriction at the base of each branch. The flabellum in *A. Mazei* tends to be more diffuse, fluffy, and irregular, and it is often greener. In three cases, we have found the two growing side by side and perfectly distinct in form, color, and in the microscopic characters of the threads, yet elsewhere specimens have sometimes been found which seem to hold a rather doubtful intermediate position. In one case (Bermuda, *no. 109*) filaments from two flabella springing from a single rhizome have different characters, those from the one being clearly of the *Mazei* type while those from the other make a close approach to the regularly moniliform condition of *A. nigricans*. The fact that *A. nigricans* and *A. Mazei* have been found wholly distinct when growing together under apparently the same conditions leads to the opinion that they should be considered separate species in spite of some present difficulties in the way of always recognizing them. Each of the two presents wide variations in form, size and color. What we believe to be a low-littoral or shallow-water condition of *Avrainvillea Mazei* forms greenish-brown, caespitose masses near low-water mark on exposed rocks, and has finger-shaped or round-capitate lobes, not developing a flabellum unless it descends a decimeter or more below the low-tide line. Among the forms that we are at present identifying with *A. nigricans*, one extreme is represented by plants with a suborbicular flabellum (reniform-cordate when young), reaching a width of 25 cm., supported by a cylindrical stipe, which has a maximum length, so far as observed, of 16 cm., this springing from a strongly developed rhizome; the other extreme has a cuneiform flabellum, sometimes no more than 1–2 cm. wide, tapering gradually to a flattened scarcely recognizable stipe, with rhizome poorly developed. Between these two extremes there seems to be a nearly perfect series of intermediates, but perhaps further familiarity with the genus, particularly with living specimens, will result in the recognition of some satisfactory basis for specific distinctions.

Cladocephalus gen. nov.

A genus of *Chlorophyceae* of the family *Codiaceae*. Thallus erect, consisting of capitulum and stipe, the latter attached to the substratum by matted rhizoids, all parts destitute of calcareous incrustation. Stipe and branches of the capitulum corticated, the medullary portion consisting of parallel, sparingly dichotomous chlorophyllose filaments, the cortical layer composed of much narrower, intricate, repeatedly divaricate-dichotomous filaments, which are finally deficient in chlorophyl. Capitulum thamnioid or scopiform, made up of numerous, irregularly dichotomous, non-zonate, often coherent or anastomosing branches. Mode of reproduction unknown.

The genus *Cladocephalus*, though having a slight superficial resemblance to *Penicillus* in habit and form, is most nearly allied to *Avrainvillea*, being in some respects intermediate between that genus and *Udotea*. It differs from both *Avrainvillea* and *Udotea* in having a thamnioid or scopiform capitulum instead of a flabellum; from *Avrainvillea* also in possessing a well-differentiated cortex; from *Udotea* also in the absence of zonation and from its corticated species in the intricate, labyrinthiform character of the cortex, which is made up of more regularly dichotomous, less pectinate filaments. *Cladocephalus* is doubtless as distinct from *Avrainvillea* as *Avrainvillea* is from *Udotea* and more so than *Rhipocephalus* is from *Penicillus*.* The genus, so far as known to the writer, is monotypic, the only species being

Cladocephalus scoparius sp. nov.

Very dark green or nigrescent when living, commonly becoming yellowish-brown, substramineous, or olivaceous on drying, solitary or gregarious, 5–14 cm. high; rhizoids forming a somewhat bulbous mass: stipe 2–10 cm. high, 3–7 mm. thick, subcylindrical or somewhat complanate, often alate or canaliculate above, simple or occasionally once or twice dichotomous, the branches sometimes again connate: capitulum scopiform, varying in outline from elongate-fusiform or elongate-ellipsoid to obovoid or subspherical, often somewhat flattened, 3–8 cm. long; branches subcylindrical or complanate, 0.3–2 mm. broad, frequently connate at points of casual contact, now and then subdenticulate near

* *Codiophyllum* J. E. Gray, judging from the author's description and figures (Ann. & Mag. Nat. Hist. IV. **10**: 139–141. *pl. 9.* 1872), is very different in structure, if indeed it is really a plant.

apices: filaments more or less fuscous in the older parts, sometimes bright-green in the younger; filaments of the cortex labyrinthine, lightly torulose when young, the ultimate branches in older parts 6–11 μ in diameter, finally subhyaline; filaments of medulla cylindrical or lightly and irregularly torulose, 30–75 μ in diameter, slightly or not at all constricted just above a dichotomy, covered by cortex at apices or rarely protruding: stipe similar to the capitulum in structure, its cortex a little thicker and firmer. [PLATE 25; PLATE 26, FIGURES 11–20.]

Rare and local in the Bahama Islands, on sandy or muddy bottom in 2–10 dm. of water (low tide): *no. 4079*, type (in a tidal pond, Georgetown, Great Exuma, 24 February 1905, M.A.H.); *no. 3081* (south shore of New Providence, 10 April 1904 — a single specimen).

Besides the single specimen collected on the shores of New Providence, we have thus far met with this remarkable plant on only one occasion, when several hundreds were found growing associated with two species of *Penicillus* in a small area in an inland pond which had been connected with the sea by an artificial canal. They seemed here to be in all stages of development, but unfortunately we have been unable to find in them anything that could be taken with confidence to be reproductive bodies. There are often, lying on and among the threads of the cortex, ovoid or subglobose bodies 40–50 μ in diameter, with densely granular contents, much resembling the supposed reproductive bodies figured by Kützing * for his *Rhipozonium lacinulatum* (*Udotea Desfontainii*); but these seem to be always free and unattached, their contents are of a little different green, and we believe that they represent an independent organism.

While the plant is uncalcified in the ordinary sense of the term, the stipe or its base is commonly infiltrated with multitudes of minute crystals which lie free in irregular clusters among the filaments, particularly of the cortex. When a piece of the stipe is dissected in a drop of water they often wash out in such numbers as to give a milky appearance to the water. The crystals dissolve with the evolution of gas on the application of acetic acid and are taken to be calcium carbonate.

The cortex is formed by branches originating subdichoto-

* Phyc. Gen. *pl. 42. III. f. 2.* 1843.

mously from the more peripheral members of the medullary strand and becoming afterwards apparently lateral. These branches then undergo repeated divaricate forkings with a gradual diminution of diameter until finally they may have only one-fifth or even one-twelfth the diameter of the filaments of the central strand.

B. NEW RHODOPHYCEAE

Sarcomenia filamentosa sp. nov.

Rose-red on drying or sometimes brownish-red, very delicate, gelatinous, gregarious or caespitose-pulvinate on other algae, 4–16 cm. long, pseudodichotomous below; main axes distinctly corticated for one-half to four-fifths the length of the plant, subcylindrical or complanate, ancipitous, 0.25–0.9 mm. in diameter near base, bearing occasional divaricate, rather rigid, simple or dichotomous septate rhizoids on the opposite lateral margins: cells of cortex polymorphous, ranging from orbicular and triangular-ovate to oblong and linear, toward base sometimes 12–16 times as long as broad: main branches dissolving above in numerous narrowly linear or ribbon-shaped articulate uncorticated branchlets 50–170 μ wide, these springing from the mid-ventral * line of the next older branch, their segments ⅔–1½ times as long as broad, consisting of four pericentral siphons and a pair of short cortical (?) siphons arranged end to end on each lateral margin, occasional marginal cells enlarged and more or less protuberant (potentially rhizoids); cross-sections of branchlets about twice as broad as high, showing a distinct costa, this especially prominent ventrally; branchlets furnished toward their apices with a secund mid-ventral row of unbranched monosiphonous filaments, these 0.2–1 mm. long, originating singly from a cell cut off from the anterior end of the ventral siphon of each segment, deciduous in older parts, cells of filament 7–20 in number, mostly 2–6 times as long as broad: reproductive organs unknown. [PLATE 27; PLATE 29, FIGURES 1–11].

On *Sargassum*, corallines, etc., washed ashore. Florida: *no. 2844*, type (Cape Florida, Biscayne Key, 29 March 1904, M.A.H. — also *nos. 2860* and *2865*); *no. 2822* (Virginia Key, 22 March 1904).

* We use "dorsal" and "ventral" in the sense in which these terms are employed by J. Agardh (Anal. Alg. Cont. 5: 122–149. 1899) in apparent conformity with the customary usage as applied to leaves of cormophytes, the "ventral" being the "inner" or "upper" side. However, a comparison with creeping species of the superficially somewhat similar genus *Herposiphonia* suggests the possibility that these terms, if used at all, should be applied in the reverse sense.

Sarcomenia filamentosa does not appear to be very closely related to any of the described species of this chiefly Australian genus. The only other species to which monosiphonous filaments are attributed are, so far as we can discover, the Australian *Sarcomenia tenera* (Harv.) J. Ag., *S. dolichocystidea* J. Ag., *S. opposita* J. Ag. and *S. secundata* J. Ag., but these are all much coarser plants with Dasyoid or Cliftonioid rather than Polysiphonioid habit, and the origin and arrangement of the branchlets and monosiphonous filaments are more or less different in all of these. In its delicate Polysiphonioid habit, *S. filamentosa* is nearer the group which includes *S. miniata* (Ag.) J. Ag. (the type of which we have seen in hb. Agardh), *S. intermedia* Grunow, and *S. mutabilis* (Harv.) J. Ag., but these differ not only in absence of monosiphonous filaments, but also in cortex characters, etc.; in *S. mutabilis*, also, the branches have a marginal or submarginal instead of mid-ventral origin.

The apparent incongruity of referring delicate plants of the *miniata* type to a genus originally based upon the fleshy membranous *Sarcomenia delesserioides* has already been remarked by Grunow * and discussed at length by J. Agardh.† In placing the above-described new species in *Sarcomenia*, we accept, for the present, the current conception of the limits of the genus.

The plant changes color and partially decomposes very soon after being collected, even though placed in a moderate amount of sea-water. It adheres most firmly to paper on drying yet recovers its form well on being soaked out if the material was originally good and properly prepared.

Dudresnaya crassa sp. nov.

Rose-colored when living, dingy-purple or brownish-red on drying, densely ramose, lubricous, subpyramidal in contour, 6–8 cm. high, the primary branches appearing irregularly 1–2-pinnate when pressed on paper, the secondary and tertiary branches then mostly confluent, unequal in length, vermiform, apices obtuse; branches of all orders of nearly uniform diameter throughout, 1–2 mm. thick in natural state, 1.5–3 mm. after pressure, all parts very closely adherent to paper: monosiphonous axis much

* Reise seiner Majestät Fregatte Novara um die Erde. Bot. Theil 1 : 93. 1867.

† Anal. Alg. Cont. 5 : 130. 1899.

obscured by the very numerous decurrent filaments, its cells 2–8 times longer than broad; peripheral filaments 4–6 times dichotomous, beautifully fastigiate, 0.5–0.8 mm. long, scarcely constricted at the joints, 5–6 μ in diameter, the more peripheral cells 2–5 times as long as broad: carpogonial branch simple, consisting of 5–19 subspherical or somewhat discoid cells in a single series, its apex slightly deflexed and terminating in the much elongated, curved or nearly straight trichogyne; auxiliary-cell branches numerous, consisting of 5–9 enlarged subspherical or oblate-ellipsoidal cells near base, terminating in a multiarticulate prolongation similar to that of the other peripheral filaments or often shorter; auxiliary-cell occupying the middle of the enlarged portion of the branch and having little more than half the diameter of the two immediately adjacent cells, the latter much inflated, rich in contents, 15–30 μ in transverse diameter: cystocarps 0.12–0.24 mm. in diameter, often 2–4-lobed: antheridia and tetrasporangia unknown. [PLATE 28; PLATE 29, FIGURES 12–26.]

On rocks in 3 m. of water (low tide), Castle Harbor, Bermuda: *no. 315*, type (6 July 1900, M. A. H.); also a floating fragment at Spanish Point, Bermuda, *no. 198*.

Dudresnaya crassa is nearest allied to *D. coccinea* (Ag.) Crouan in the structure of the carpogonial branch and the auxiliary-cell apparatus and in the elongated cells of the peripheral filaments, but is very different in size and habit, in the obtuse ultimate branches which have nearly the diameter of the primary, in having its peripheral filaments 2–4 times as long as in *D. coccinea*, and in the highly specialized auxiliary-cell, which is always much smaller than the conspicuously enlarged adjacent cells. Thuret states* that in *D. coccinea* the branches which bear the antheridia occur on the same plants that bear the cystocarps; in *D. crassa*, the antheridia have been searched for in vain on the cystocarpic individuals — the only sort collected — and the species is believed to be dioicous. In its dense habit of branching, the species bears a closer superficial resemblance to *D. purpurifera* J. Ag., though the branches are obtuse and coarser; however, in structure of the carpogonial branch and the auxiliary-cell apparatus † and in the character of the peripheral filaments, it differs so widely that no detailed comparison is necessary.

* Bornet & Thuret, Notes Algologiques, 36. 1876.

† See Oltmanns, Morphologie und Biologie der Algen 1: 688–691. *f. 441a, 441*. 1904.

The only specimen from the American side of the Atlantic which has heretofore been referred to the genus *Dudresnaya* is, so far as we know, one collected in the Tortugas, Florida, by Mrs. G. A. Hall and described as new by J. Agardh in 1899 under the name "*Dudresnaja canescens*" (Anal. Alg. Cont. **5**: 88). This, however, is a plant of entirely different habit from ours and is not a *Dudresnaya*, as a recent examination of the single type-specimen in hb. Agardh has shown.

The auxiliary-cell branches and cystocarps are very abundant in our material and we have been able to observe nearly all stages in their development and mutual relations, though without any serious attempt to study the internal cytological changes. In their general features, the fusion of the sporogenous filament and the auxiliary-cell and the subsequent development of the cystocarp take place very much as described and figured for *D. coccinea* by Bornet and Thuret and by Oltmanns. However, Thuret's description (*l. c.*) gives the impression that the fusion can take place with any one of three similarly enlarged cells of the auxiliary branch, while in *D. crassa* it seems always to occur with a single definite highly specialized cell lying between the two larger ones. The content of this cell appears at first very much like that of the adjacent cells, but as it matures it undergoes a change, becoming more homogeneous and translucent; at the same time the auxiliary-cell and the two neighboring cells become enveloped in an especially thick layer of mucus which stains yellowish with safranin. We regret that the behavior of the carpogonial branch after fertilization has escaped observation in this species. Carpogonia occur in moderate number in our material (we have seen 25 or 30), but all seemed unfertilized; and the sporogenous filaments travel such long distances that we have failed in attempts to trace them back to their ultimate source.

The type-specimen — *no. 315* — is associated with a *Chantransia*, which permeates it, more or less, and fringes its surface.

C. MISCELLANEOUS NOTES

CAULERPA CRASSIFOLIA (Ag.) J. Ag. Till Alg. Syst. **1**: 13. 1872

Caulerpa taxifolia β crassifolia Ag. Sp. Alg. **1**: 436. 1822. (Excluding synonymy.)

Caulerpa pinnata Web.-v. Bosse, Ann. Jard. Bot. Buitenzorg **15**: 289. 1898. Not *Fucus pinnatus* L. fil. Suppl. 452. 1781.

Under the name *Fucus pinnatus* * in the Linnaean herbarium, now in possession of the Linnean Society of London, is a single sheet of four or five fragmentary specimens which agree with the somewhat detailed original description sufficiently well to leave no reasonable doubt that they represent the type material of that species. The natural form of the plant is somewhat modified by drying and pressure, yet it is evident that the pinnules are cylindrical (or clavate), as afterwards figured and described by Turner (Hist. Fuc. **1**: 117. *pl. 53.*) and that the plant belongs in the section *Sedoideae* (J. Ag.) of *Caulerpa*, being close to *C. racemosa corynephora* (Mont.) Web.-v. Bosse.† In the younger parts of the specimens the pinnules are distinctly inflated at their apices and are less regularly distichous; it is probable that this character suggested the Linnaean words which puzzled Turner: "Inflorescentia est racemus ex verticillis cum fructificationibus pedicellatis, peltatis, planis."

Madame Weber in her scholarly "Monographie des Caulerpes" refers to an authentic specimen of the *Fucus pinnatus* of Turner in the herbarium of the British Museum. This specimen of Turner's we have not seen, but if it belongs to the Filicoid rather than the Sedoid group, the apparent disagreement with Turner's description and figure should suggest doubts as to its authenticity or suggest the possibility that Turner's material was mixed. In any event, the true type of *Fucus pinnatus* L. fil. should be sought in the Linnaean herbarium rather than in that of the British Museum.

In the Agardh herbarium at Lund are two specimens which, judging from the original citation, probably served as originals of the "*Caulerpa taxifolia β crassifolia*." Of these only one is actually associated with the name *crassifolia*; this is a fragment in a pocket inscribed "Caul. taxifolia var. crassifolia Ag. e mari Antillarum mis. Sprengel." This is suggestive of the familiar figure of *C. crassifolia* given in the Pflanzenfamilien of Engler and Prantl,

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* Mr. B. Daydon Jackson informs me that the handwriting is that of the younger Linnaeus, whom he considers to be the real author of the "Supplementum."

† Ann. Jard. Bot. Buitenzorg **15**: 360, 364. *pl. 33. f. 10–13.* 1898.

and attributed to Sachs, except that the pinnules are scarcely narrowed at the base and are of course flatter than indicated in that figure. The second specimen — which is of the same species — is marked "Fucus taxifolius Vahl variet. C. M. 1821. ex Ind. occ." The "In mari Indico & rubro" habitat, also cited by C. Agardh in his original publication of "*β crassifolia*" was evidently derived from the erroneously identified *Fucus pinnatus* of Linnaeus fil. and of Turner, which he cites as a synonym. J. Agardh apparently had become suspicious of the alleged synonymy, for (Till Alg. Syst. **1**: 14) he remarks, "utrum synonyma ibidem allata * * * ad eandem pertineant, dicere non auderem."

Caulerpa sertularioides (S. G. Gmel.)

Fucus sertularioides S. G. Gmel. Hist. Fuc. 151. *pl. 15. f. 4.* 1768.

Fucus plumaris Forsk. Fl. Aegypt.-Arab. 190. 1775.

Caulerpa plumaris Ag. Sp. Alg. **1**: 436. 1822. — J. Ag. Till Alg. Syst. **1**: 15. 1872. — Web.-v. Bosse, Ann. Jard. Bot. Buitenzorg **15**: 294. 1898.

That Gmelin's *Fucus sertularioides* is the same as the plant commonly known as *Caulerpa plumaris* is admitted by J. Agardh and, more recently, by Madame Weber-van Bosse. Gmelin's figure and description seem sufficiently conclusive; his plant was American ("in corallis americanis"), though no definite locality is given. The rulings of the recent International Botanical Congress at Vienna, though professedly applying only to the spermatophytes and pteridophytes, are explicit as to the maintenance of the oldest specific name.

Acetabulum Farlowii (Solms)

Acetabularia Farlowii Solms, Trans. Linn. Soc. Bot. II. **5**: 27. *pl. 3. f. 1.* 1895.

This species was founded upon three somewhat imperfect plants sent by Farlow to Thuret. In the place of publication the material is said to have come from the "southern point of Florida, Key West," but Professor Farlow writes us that the alga was collected in Biscayne Bay, Florida, by Dr. E. Palmer in 1874. At the close of the original description, which was necessarily brief from lack of material, Count Solms expresses the hope "that this remarkable plant will be found again soon."

On November 11, 1902, the writer found on the northeastern shore of the island of Key West, a considerable quantity of a handsome little *Acetabulum* growing attached to shells, stones, broken pieces of coral, etc., at just about the low-water line and rather closely confined to this zone. Adjacent, in water that was from 1 to 10 dm. deep at low tide, and occasionally approaching and intermingling with the lower-growing individuals of this small green *Acetabulum*, were numerous clusters of the larger, whiter, more rigid, and more strongly calcified *Acetabulum crenulatum* (Lamour.) Kuntze. A hand-lens showed the strong cusp or apiculum with which each ray of the disc in *A. crenulatum* always terminates in in the younger stages at least, while the rays in the smaller species appeared to be entirely destitute of an apiculum even in the youngest conditions that could be observed at the time. Confident that two species were represented by the specimens growing at this point and finding on returning to New York that the smaller plant evidently had much in common with the *Acetabularia Farlowii* as described and figured by Solms, we submitted specimens of it both to Count Solms and Professor Farlow, both of whom approved the reference to *A. Farlowii*, though with a certain amount of cautious reserve in view of the scantiness of the original material.

In March 1904, the writer again found *Acetabulum Farlowii* in abundance, this time at Miami, Florida, and at Cutler, both on Biscayne Bay. Here again, the *A. Farlowii* was confined to a rather narrow zone near the low-water mark, while *A. crenulatum* (which in Biscayne Bay is more profusely abundant than we have yet seen it elsewhere), with a wider range, had its best development in deeper water (best in 3 dm. to 4 m., low tide). The zones occupied by the two species occasionally, however, overlapped; the individuals intermingling in this common region were, as a rule, easily referred at sight to the one species or the other, though once in a while an individual was met with whose affinities seemed at first a little dubious. Yet we believe that the two are actually and always distinct and distinguishable and that the principal diagnostic characters may be contrasted as follows:

Acetabulum crenulatum

Discs usually well-calcified and whitish on drying, often 2 or 3 superposed, commonly infundibuliform or cyathiform, 5–15 mm. broad; sporangia (rays) mostly 35–60, persistently coherent, strongly apiculate in early stages, the apiculum sometimes obscure with age; aplanospores 200–500 to a sporangium.

Acetabulum Farlowii

Discs lightly calcified, green on drying, solitary, nearly plane, 4–7.5 mm. broad; sporangia (rays) mostly 20–30, lightly coherent or often separate and free, rounded-obtuse or truncate at apex from an extremely early stage; aplanospores 40–120 to a sporangium.

The feature in which, chiefly, the original description given by Solms needs amendment is in regard to the coherence of the rays. *A. Farlowii* was placed by Solms in a group with *A. Calyculus* under the caption "Rays even in the living state separate and free." An examination of some thousands of individuals in the living state leads us to the opinion that only about one in four or one in five has the rays separate and free. However, clusters of plants are found in which the rays of nearly every disc are discrete; other clusters in which the rays nearly always remain coherent, forming discs that are slightly concave or almost plane. In some cases, the rays are apparently discrete from the first; in others, they have probably become more or less separated by mechanical agencies.

Specimens of *Acetabulum Farlowii* obtained by the writer at Key West under the collection number *1676* were distributed in the Phycotheca Boreali-Americana as *no. 1032.* We have not met with the species in the Bahama Islands; so far as known, it is confined to southern Florida.

BATOPHORA OERSTEDI J. Ag. Öfvers. Kongl. Vet.-Akad. Förh. **11**: 108. 1854.

Dasycladus Conquerantii Crouan; Schramm & Mazé, Essai Classif. Alg. Guadeloupe, 47. 1865.—Mazé & Schramm, Essai Classif. Alg. Guadeloupe, 108. 1870–77. [According to specimens in hb. Mus. Paris., and hb. Mus. Brit., distributed by Mazé and by Mazé & Schramm.]

Botryophora Conquerantii Cramer, Neue Denkschr. Schweiz. Naturf. Ges. **32**: 6. *pl. 4. f. 1.* 1890.

Coccocladus occidentalis Conquerantii M. A. Howe, Bull. Torrey Club **31**: 96. 1904.

Coccocladus occidentalis laxus M. A. Howe, *l. c.* 95. *pl. 6. f. 1, 2.*

Batophora Oerstedi occidentalis (Harv.)

Dasycladus occidentalis Harv. Ner. Bor.-Am. **3**: 38. *pl. 41B.* 1858.

Botryophora occidentalis J. Ag. Till Alg. Syst. **5**: 141. 1887.

Coccocladus occidentalis Cramer, Neue Denkschr. Schweiz. Naturf. Ges. **30**: — (37). 1887.

The discovery that *Batophora Oerstedi* was published by J. Agardh four years previously to Harvey's *Dasycladus occidentalis*, and that it was apparently forgotten even by J. Agardh himself, is a good illustration of the surprises which must now and then await any one who is partial to the cause of priority in botanical nomenclature. In 1854 J. Agardh published a very full description both of "*Batophora*, J. Ag. mscr. Gen. nov. ex Siphonearum familia inter Oliviam et Dasycladum intermedium" (*l. c.* 107) and of its single species, *Batophora Oerstedi*, "Hab. ad radices Rhizophorae Mangle in sinu substagnante 'Krauses lagoon' dicto, ad Insulam St. Crucis: Oersted." In 1887, in publishing "Botryophora J. Ag. mscr.," he alludes to his already having designated the plant *Botryophora Oerstedi* in a collection of algae made by Oersted, even before Harvey published *Dasycladus occidentalis*, but there is no reference to his having already actually printed a description of the proposed new genus under a somewhat different generic name and this fact appears to have been overlooked, so far as we can discover, by all subsequent phycologists and bibliographers. If any evidence were needed that this omission on the part of Agardh was due simply to a lapse of memory and not to any intent to ignore, it would be furnished by his attitude toward certain other species and names published in the same paper.*

Possibly it may be objected that "Batophora" is a misprint for the "Botryophora" of thirty-three years later. To this it may be replied that "Batophora" is well formed etymologically, is fully

* *E. g.*, *Bryopsis Duchassaingii* J. Ag. Öfvers. Kongl. Vet.-Akad. Förh. **11**: 107. 1854. — "Hoc nusquam a me publici juris factum, jamdudum oblitum credidissem" (Till Alg. Syst. **5**: 31. 1887).

as significant and appropriate as "Botryophora," and in the Agardh herbarium the name *Batophora Oerstedi* appears in connection with one of Oersted's specimens.

In the Agardh herbarium are several small sheets of specimens which probably served as the original materials of *Batophora Oerstedi.* Three of these are fastened to a larger sheet; the others are loose in another cover with a loose label. Only one (one of the fastened sheets) has an individual inscription and this is inscribed simply "*Batophora Oerstedi.*" The specimens illustrate the condition of the species which is found in quiet and often merely brackish water — a condition characterized by large size, lax habit, and obovoid or oblong-ellipsoidal sporangia, which occur at the ends of the branches of the first three orders. *Coccocladus occidentalis laxus* M. A. Howe is a form that is very common in the Bahama Islands, growing in interior ponds of which the nearly fresh water responds only slightly to the changes of the tides — often associated in about equal abundance with *Chara Hornemanni* and *Ruppia maritima.* Since seeing authentic material of *Batophora Oerstedi* and *Dasycladus Conquerantii* and since studying these plants in the living condition on two visits to the Bahamas, we hardly think it worth while to maintain the subspecific name *laxa.* The contrast in size and habit and in form and position of sporangia, between the lax plants of the interior brackish ponds and the condensed ones of the border of the open ocean (here placed under the subspecific name *occidentalis*) is remarkably striking, yet the peculiarities of each, we believe, are directly connected with the degree of salinity and quietness of the water. Intermediate forms occur in places of intermediate character.

NEOMERIS COKERI M. A. Howe, Bull. Torrey Club **31**: 97. *pl. 6. f. 3–12.* 1904

This strongly marked species, described from material collected by Professor Coker in 1903, on the island of Eleuthera, Bahamas, is not uncommon throughout the Bahamian archipelago, ranging at least from the Great Bahama on the north to the Great Exuma on the south. Its usual habitat is under shelving rocks near the low-water line. The original description was based on rather small individuals having a length or height of 7–14 mm.

A maximum height of 37 mm. has since been observed and the spores are sometimes oblong-ellipsoidal instead of obovoid.

FUCUS SPIRALIS L. Sp. Pl. 1159. 1753

The above name has now and then since the time of Linnaeus been applied by European writers to certain forms of North European rockweeds representing doubtless two species, the one always synoicous, the other a condition of the always dioicous *F. vesiculosus.* In America, the name has had little vogue, except as used by Farlow * and others for a variety of *F. vesiculosus*, without citation of Linnaeus. In 1883, Kjellman in "The Algae of the Arctic Sea" † definitely recognized *Fucus spiralis* L. as a species, though in 1890 ‡ he renamed the species *Fucus Areschougii* Kjellm., having apparently become doubtful as to the identity of the Linnaean plant. De-Toni §, however, a little later, quotes *F. Areschougii* as a synonym of *F. spiralis* L. without any indications of doubt, and more recently Börgesen ‖ has given a detailed discussion of the subject, in which he considers not only *F. Areschougii* Kjellm. but also *F. platycarpus* Thuret to be synonyms of *F. spiralis* L. Börgesen's determination of *Fucus spiralis* rests chiefly on the Linnaean descriptions. As is well known, the comparatively modern idea of nomenclatorial type-specimens was not recognized by Linnaeus, and the herbarium that he left is not always satisfactory or conclusive to the one who would see the materials that he actually had before him in writing his descriptions. Nevertheless, the specimens in the Linnaean herbarium to which we may believe Linnaeus himself attached the name *spiralis* are of much interest in this connection and it may be said that they seem to support Börgesen's position. There are under this name in the Linnaean herbarium, which we were permitted to examine through the courtesy of Mr. B. Daydon Jackson, two specimens fastened to separate sheets, each inscribed at the bottom "4 spiralis" in Linnaeus' hand. Both specimens are fertile and both are without vesicles. The wholly justifiable restrictions placed

* Mar. Alg. N. E. 101. 1881. — Farl. And. & Eat. Alg. Exsic. Am. Bor. *109 bis.*

† Kongl. Sv. Vet.-Akad. Handl. 20^5: 202.

‡ Handb. Skand. Hafsalgflora, 11.

§ Syll. Alg. 3: 207. 1895.

‖ Mar. Alg. Faeröes, 472–477. 1902.

upon the use of this historic collection did not permit any attempts to determine whether the plants are synoicous or dioicous, but one, at least, of the two, is, in our opinion, very clearly a rather small specimen of the typical *Fucus Areschougii* Kjellm. This specimen is 10 cm. high, the branches are somewhat contorted and 4–6 mm. broad above, the distinct costa alone persisting in most of the lower half; the receptacles are ovate, obovate or suborbicular, and 5–8 mm. long. It evidently represents a form of the synoicous species which on the eastern coast of North America is common from Maine to Newfoundland and doubtless ranges farther north; it is confined to a rather narrow zone near the high-water mark. Specimens illustrating this form from Cape Rosier, Maine, were issued as *no. 234* of the Phycotheca Boreali-Americana of Collins, Holden & Setchell under the name *Fucus Areschougii* Kjellm. The other Linnaean specimen cannot be so confidently determined without dissection, yet we have little doubt that it also represents a condition of the same synoicous species. This is a larger, uncontorted plant, with more elongated receptacles and more conspicuous cryptostomata, and the wings are more persistent below; it is about 20 cm. high, the even-topped branches are 4–8 mm. wide, the verrucose receptacles are 8–20 mm. long, mostly 2–3 times as long as wide, though one or two are suborbicular. This appears to exemplify a form of the species which in North America is rather more southern in its range than the other, being not uncommon near the high-tide line in Long Island Sound within the limits of New York City. This more southern form occasionally approaches *Fucus platycarpus* Thuret in habit, and specimens from Marblehead Neck, Massachusetts, were distributed under that name in the Phycotheca Boreali-Americana, *no. 1132*; however, we have seen no American specimens in which the receptacles are as pronouncedly lateral as in the typical *F. platycarpus* of northern France. The larger forms of *Fucus spiralis* are sometimes imitated by certain evesiculose conditions of *F. vesiculosus*, but can be distinguished by being always synoicous and usually also at sight by having more strongly verrucose and more margined receptacles. It grows typically in a higher zone on the rocks than does *F. vesiculosus.* Vesicular inflations are occasionally present, but they are much elongated and irregular in form and position.

It is of interest to add that the writer has sent photographs of the two Linnaean specimens of *Fucus spiralis* to Dr. Börgesen, who writes: "One of them is a true *Fucus spiralis* (= *F. Areschougii* Kjellm.), the other is a little dubious, it may be *Fucus spiralis*, but it also very well may be a form of *Fucus inflatus*."

FUCUS POITEI Lamour. Diss. 63. *pl. 31. f. 2, 3.* 1805

That the *Fucus Poitei* of Lamouroux was a *Laurencia* seems to have been suspected first by the keen-eyed Kützing.* J. Agardh, a little later, judging, as would appear from his discussion, only from Lamouroux's description and figures (and possibly somewhat influenced by the fact that Lamouroux in 1813 placed the plant in *Chondrus* instead of in *Laurencia*), referred this *Fucus Poitei* to the very different genus *Gracilaria* and expressed his confidence in the correctness of this determination by writing an exclamation mark after the citation. Since that time, so far as we can discover, this determination has not been questioned and "*Gracilaria Poitei* (Lamour.) J. Ag." has held a place in general monographs and in special papers relating to West Indian algae.

In the herbarium of Lamouroux at Caen, which we had the privilege of seeing in the summer of 1904 through the courtesy of Professor Octave Lignier, there are in the cover devoted to this species a single small mounted specimen (4 cm. high, 6.5 cm. broad), two loose fragments, a loose slip of paper inscribed "fucus poitei" in the handwriting of Lamouroux, and two drawings marked "fig. 3" and "fig. 4^me^." Fig. 3 was published as *f. 2*; fig. 4^me^ as *f. 3*. The specimens, which Lamouroux's good diagnosis and rather poor figures allow us to assume, with much confidence, to be parts of the original, belong to the genus *Laurencia* and to the common West Indian species described by J. Agardh under the name *L. tuberculosa* † and afterwards figured and described by Kützing as *L. mexicana*.‡

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* Species Algarum, 857. 1849.

† Sp. Alg. **2**: 760. 1852.

‡ Tab. Phyc. **15**: 25. *pl. 70. f. c. d.* 1865.

Explanation of plates 23-29

Plate 23

1. *Avrainvillea levis.* Photograph of two dried specimens(*no. 3996*, type —, Cave Cays, Exuma Chain, Bahamas, 19 F 1905, M. A. H.), natural size.

2. *Halimeda favulosa.* Photograph of about one half of one segment of a dried specimen (from *no. 3981*, type), magnified sixteen diameters.

Plate 24. *Halimeda favulosa*

Photograph of dried specimen (*no. 3981*, type —, Cave Cays, Exuma Chain, Bahamas, 19 F 1905, M. A. H.), reduced to about two-thirds the natural dimensions.

Plate 25. *Cladocephalus scoparius*

Photograph of formalin-preserved specimens (*no. 4079*, type —, Georgetown. Great Exuma, Bahamas, 24 F 1905, M. A. H.), natural size. The young plant at the right with the truncate apex shows only the beginning of the differentiation of the capitulum; the other two short plants represent later, though still very immature, stages in the development of the capitulum — in one the stipe is furcate above, the two branches again coalescing; the three largest specimens are typical full-grown plants.

Plate 26

1–6. *Halimeda favulosa*

1–3. Peripheral utricles, decalcified, in lateral view.

4. Peripheral utricles with dense granular content (see page 565).

5. Peripheral utricles in surface view, decalcified.

6. Filaments of the central strand, showing mode of union at the nodes.

Figures 1–6 are all enlarged 40 diameters and are all drawn from the type material, *no. 3981* (Cave Cays, Exuma Chain, Bahamas).

7. *Halimeda tridens*

7. Peripheral utricles, decalcified, in lateral view, $\times 40$. Introduced for comparison with *H. favulosa.*

8–10. *Avrainvillea levis*

8. One of the larger filaments from the flabellum, with dichotomy.

9. A filament of the usual size, from flabellum.

10. A filament from apical margin of flabellum, with wide-angled dichotomy.

Figures 8–10 are all enlarged 150 diameters; 8 and 9 are drawn from the type material, *no. 3996* (Cave Cays, Exuma Chain, Bahamas); 10, from *no. 3966.*

11–20. *Cladocephalus scoparius*

11. One of the main branches of the capitulum, showing ramification, natural size. The left-hand side was toward the middle of the capitulum.

12. A detail of the branching of the capitulum, showing anastomoses, $\times 2$.

13. Cross-sections of branches of the capitulum, $\times 4$.

14. Fragment of a branch of the capitulum in surface view with part of cortex removed, disclosing medullary filaments, $\times 55$.

15. Medullary filament from apex of capitulum, $\times 55$. The branch at the left, now becoming lateral, represents the beginning of the cortical system.

16. The branch at the right represents a later stage in the development of the cortex, $\times$ 55.

17. Cross-section of stipe, $\times$ 4.

18. Cortical region of stipe in cross-section, $\times$ 150. Drawn from a microtome section 20 μ in thickness.

19. A stage in the differentiation of the cortical filaments later than that shown in figure 16, $\times$ 55.

20. Final form of cortical filaments of capitulum, $\times$ 150.

Figures 11–20 are drawn from formalin-preserved material of the type, *no. 4079* (Georgetown, Great Exuma, Bahamas).

PLATE 27. *Sarcomenia filamentosa*

Photograph of dried specimen (*no. 2844*, type —, Cape Florida, 29 Mr 1904, M. A. H.) attached to *Sargassum*, natural size.

PLATE 28. *Dudresnaya crassa*

Photograph of dried specimen (*no. 315*, type —, Castle Harbor, Bermuda, 6 Jl 1900, M. A. H.), natural size.

PLATE 29

1–11. *Sarcomenia filamentosa*

1. Apex of polysiphonous branchlet, ventral view, showing apical cell and origin of the paired marginal cells and of the monosiphonous filaments, $\times$ 193.

2. Older part of branchlet, dorsal view, $\times$ 193.

3 and 4. Cross sections of uncorticated branchlets, ventral side downward, $\times$ 193.

5. Apical portion of uncorticated branchlet, with the unifarious monosiphonous filaments, $\times$ 48.

6. Branchlet viewed from margin, showing bases of the monosiphonous filaments, $\times$ 193.

7. Part of an older branch, ventral view, showing origin of polysiphonous branchlet (really from axial siphon), $\times$ 44. Marginal cells at somewhat regular intervals are enlarged and protuberant (potentially rhizoids). The monosiphonous filaments have here disappeared, but the cell cut off from the anterior end of the ventral siphon marks their former position in each thallus-segment. Small intercalary cells, originating chiefly from the pericentral siphons, constitute the beginning of the cortex.

8. A similar branch, dorsal view, $\times$ 44. The rhizoids are here growing out.

9. Surface view near the base of one of the largest stems seen, showing cortical cells, $\times$ 40.

10. Cross-section of a similar main stem $\times$ 44.

11. Cross-section of an ordinary main axis in the basal third of the plant, $\times$ 44.

Figures 9 and 10 are drawn from our *no. 2860*; figures 1–9, and 11 are from the type material, *no. 2844* (Cape Florida).

12–26. *Dudresnaya crassa*

12. Outer portion of peripheral filament.

13–15. Carpogonial branches.

16 and 17. Auxiliary-cell branches; auxiliary-cell occupying middle of enlarged portion, lying between two much larger cells.

18–22. Fusion of sporogenous filament with auxiliary-cells; in figure 21, two cells (indicated by dotted lines) appear in the position formerly occupied by the auxiliary-cells; in figure 22, three cells occupy this position — the protruding one at the left will form the main body of the cystocarp or one lobe of it.

23–26. Cystocarps, showing relation to original auxiliary-cell branch and to the sporogenous filaments. The small peduncled cystocarp, developed at some distance from the original auxiliary-cell, shown in figure 26, is abnormal. Figures 24 and 25 show mature cystocarps, the one unilateral, the other more symmetrical and 3-lobed.

Figures 12–26 are all enlarged 193 diameters and are all drawn from the type material, *no. 315* (Castle Harbor, Bermuda). The outer limits of the gelatinous cell-walls are scarcely visible except by staining and the lines as drawn give an exaggerated idea of their distinctness.

Addendum

While this paper is going through the press and is in the paged-proof stage, an opportune communication from Mr. J. R. Tovey, acting curator of the National Herbarium of Victoria, Australia, reaches us, enclosing a portion of the original specimen of Kützing's *Halimeda brevicaulis*, a species which is discussed on page 564. As is true in the case of several other species, Kützing evidently saw the plant in "Herb. Sonder," which is now in the possession of the National Herbarium of Victoria. The label of the specimen in question, a transcription of which we owe to the kindness of Mr. Tovey, reads, "*Halimeda brevicaulis* Kuetz. Tab. Phyc. VIII. tab. 25. India occidental." In the place of original publication, the locality is given as "Bahamas-Inseln," but the fragment sent by Mr. Tovey is manifestly the very one sketched by Kützing in his figure *b*. The plant is not *Halimeda favulosa*; as already surmised (page 564), it is probably to be considered a lax flaccid condition of *H. tridens* (*H. incrassata*). The peripheral utricles, however, are rather larger than is usual in *H. tridens*, measuring 50–80 μ in diameter in surface view; the filaments of the central strand cohere at the nodes.

Mr. Tovey kindly sends us also fragments of the flabellum and stipe of Kützing's *Rhipilia longicaulis*, to which we have alluded on pages 567 and 568. These indicate clearly, we think, that the species is the same as the more recently published *Avrainvillea Mazei* Murr. & Boodle. The filaments of the flabellum are now and then slightly torulose, but they are mostly cylindrical without constrictions, except for the strong one where they leave the dichotomy; the ends of some of the branches are thin-walled and shriveled, but they are not destitute of chlorophyl and should not be considered hairs.

The genus Alcicornium of Gaudichaud

Lucien Marcus Underwood

The adoption of 1753 as the initial date for botanical nomenclature in the Rochester rules of 1892, ratified by the Genoa botanical congress in the same year, reiterated by various botanical organizations down to the present year, and now almost universally accepted by botanists, settled a supplementary but more fundamental problem which had hitherto been an obstacle to the progress of a correct understanding of genera. The principle thus established is briefly stated as follows: *A genus is a group of closely related species and not a definition.* The converse view of this principle has led to untold misconceptions in regard to a proper understanding of what genera really are, particularly among the ferns. If a species has no near relations it will form a monotypic genus concerning whose nomenclatorial type there can be no question; nevertheless, in the practice of the past, generic names of this sort have often been passed along from the original monotype to species later added, until in their present acceptance they would not be recognized by their founders. Linnaeus' *Species Plantarum* contains no diagnoses of genera, and as a necessary corollary, a genus may be founded at any time by giving a generic name to a species or group of species. Such a genus is "*rite* published," to quote an expression from an author on whose restrictions this article is in part a protest. Botanical literature has frequent examples of such publications, of which I cite a single one which has recently been accepted without question:

In an "observatio" appended to the description of the genus *Bolbitis*, Schott (Gen. Fil. *pl. 14*) says: "Praeter *Bolbitin* alia duo genera: *Elaphoglossum* et *Rhipidopteris*, ab Acrostichis genuinis sunt segreganda. Prioris generis exempla sunt: E. simplex, conforme, apodum, viscosum, vestitum, etc. (Acrost. simplex, conforme etc. Auctorum); posterioris * * *." (1834.)

This is the proper starting point of the genus *Elaphoglossum*, and no one has seemed to take the gerundive construction in any other way than an intention on the part of the author to here establish a new genus. A few years earlier Gaudichaud, in the narrative of his report on the voyage of *l'Uranie* says (page 48): "On trouve de plus une fougère très-remarquable qui abonde sur les rameaux de tous les tamariniers: c'est l'*Acrostichum alcicorne*, ou du moins une espèce ou variété du genre (*Alcicornium*) qu'on ne manquera pas de faire de ces plantes dès qu'elles seront mieux examinées." We can hardly discern the distinction between this case and that of *Elaphoglossum*, and we must consider the genus *Alcicornium* as "*rite* published" by the association of a generic name with a type species; and Mr. Christensen, who includes among certain just criticisms * of my recognition of fern genera of the Old World a rejection of this genus, is surely inconsistent in taking up *Elaphoglossum* while denying validity to *Alcicornium*. It is true that in the latter case Gaudichaud withdrew his name in the same work (page 307), but there was an interval of nearly two years between the first publication and the second,† during which Desvaux published the genus *Platycerium* more formally, and Gaudichaud with the characteristic "après vous, monsieur" of French courtesy simply withdrew his genus in deference to Desvaux. It is a generally recognized principle of biological nomenclature that "a name is a name," and that a genus once published cannot be withdrawn from nomenclature even by its own author. The only reason for withdrawing a published name is the proof that it is either a synonym or a homonym. If Desvaux had not published *Platycerium* in 1827 no one would have hesitated to cite *Alcicornium* as dating from its first publication at page 48 of Freycinet's voyage in 1826. On the principle of priority of publication, therefore, we must accept the name *Alcicornium* as the proper designation for the unique genus of stag-horn ferns.‡ If

* Christensen. On the American species of *Leptochilus* sect. Bolbitis. Bot. Tidssk. **26**: 283–300. 1904. Much of Mr. Christensen's criticism is based on a misconception of my point of view; our conceptions of the limitations of genera are wholly different. In the single case of *Belvisia* I had overlooked the synoptical publication of the genus in which the order of the species is inverted from that in its more formal publication in the text. This transfers *Belvisia* from *Acrostichum spicatum* to *A. septentrionale* (*Asplenium septentrionale* Hoffm.).

† The date of the publication of pages 1–48 of Freycinet's voyage is 1826. The date of the publication of pages 265–312, including the withdrawal of *Alcicornium*, is 1828. *Cf.* Jour. Bot. **39**: 206. 1901.

‡ In raising this group to a tribal alliance (Bull. Torrey Club **30**: 672) we overlooked the fact that this had already been done by the acute John Smith in his *Historia Filicum*, 122. 1875. We would now exclude from the tribe the peculiar genus *Cheiropleuria* placed in this alliance by Diels (Die nat. Pflanzenfam. 1[4]: 336) as more properly representing, in its vascular system particularly, a high degree of differentiation in the tribe *Acrosticheae*.

we were to decide nomenclature on a principle of purely temporizing expediency and in entire disregard of principles, as advocated at the recent Vienna congress, we might argue the continuance of the name *Platycerium*, but once adopting the principle of priority of publication as a fundamental law and the date of 1753 as initial, which annuls the old conceptual idea of a genus, we are forced to adopt *Alcicornium*.

The stag-horn ferns, which have attracted attention since the time of Plukenet, two centuries ago, by their bizarre appearance and habit of growth, are, with one exception, confined to the tropical and sub-temperate regions of the Old World. Except for Hooker's treatment in *Species Filicum* they have never been monographed, and as the recent literature relating to individual species is greatly scattered we present this preliminary revision with references to the numerous illustrations that have been published, particularly since these ferns are attracting considerable attention in cultivation at the present time. In this connection we shall attempt to elucidate the nomenclatorial tangle not only of the generic name but of the specific name of one of the commonest species, since two of the species of the genus have been more or less mixed during their entire history.*

In 1705 Plukenet (Amal. Bot. *pl. 429. f. 2*) figured a sterile African plant with the designation *Neuroplatyceros aethiopicus, nervosis foliis, cornu cervinum referentibus* (page 151).

Müller, in 1785, described *Osmunda coronaria* (= *Alcicornium coronarium*) from Siam.

Willemet was the first to describe *Acrostichum alcicorne*, in 1796 (Usteri, Ann. 6[18]: 61), as follows:

> *Acrostichum* (*alcicorne*) frondiformibus lobatis: lobis dichotomis. N. Habitat in Madagascaria.
>
> Stadtmannus plantam siccam dabat.
>
> Fructificatio non adest in meo specimine. In altero loborum aversam partem occupabat.

In 1799 Cavanilles (Anal. Hist. Nat. **1**: 105) described *Acrostichum bifurcatum* from Port Jackson, New Holland.

In Schrader's Jour. für die Botanik (**1800**[2]: 11. 1801) Swartz described an *Acrosticum alcicorne* with no reference whatever to

* *Cf.* Carruthers. The Nomenclature of *Platycerium*. Jour. Bot. **38**: 123–125. 1900. Mr. Carruthers gives a number of interesting points on the early history of the species, but does not begin to fathom the nomenclatorial difficulties.

Willemet but cited Plukenet's figure; he apparently mixed two species in his account in his expressions "*laciniis * * * versus apices fructiferis*" and "*foliis primordialibus reniformibus lobatis venosis.*"

In 1804 Schkuhr (Crypt. Gewächs. 1. *pl.* 2) reproduced Plukenet's figure in color, adding Willemet's citation with a ?, using the name *Acrostichum alcicorne* without adding to the knowledge of the subject.

In 1806 Palisot de Beauvois (Fl. d'Oware et de Benin. 2. *pl.* 2) described and figured *Acrostichum Stemaria* in color, collected by Commerson in Madagascar.

In 1806 Swartz (Syn. Fil. 12 and 196) jumbled most that had been previously published under the name *Acrostichum alcicorne*, citing Plukenet, Cavanilles, and Schkuhr. Among his "*Inquirendae*" (page 17) he placed the citation of *Acrostichum alcicorne* Willemet.

In 1810 Willdenow, with a modified description of his own, continued the same jumble of references (Sp. Pl. **5**: 111).

In 1827 Desvaux (Mém. Linn. Soc. **6**: 213) established the genus *Platycerium* with the following species:

P. ALCICORNE = *Acrostichum alcicorne* Sw. in part.
P. STEMMARIA = *Acrostichum Stemaria* Beauv. (*A. bifurcatum* Cav.?).
P. ANGUSTATUM = *A. alcicorne* R. Br. Prod. Fl. Nov. Holl. 145, not Sw.
P. CORONARIUM = *Osmunda coronaria* Müll. (*Acrostichum biforme* Sw.).

Presl 1836 (Tent. Pterid. 239–240) took up *Platycerium* with three species:

P. alcicorne Gaud. (*P. angustatum* Desv.).
P. biforme (*P. coronarium* Desv., *Acrostichum biforme* Sw.).
P. Stemaria (*Acrostichum Stemaria* Beauv.).

In 1841 John Smith added a fourth species (Jour. Bot. **3**: 402) from the Philippines as *Platycerium grande* ("*Acrostichum grande* A. Cunn."), which remained a *nomen nudum* until it was described in 1845 as *Nevroplatyceros grandis* Fée, Mém. Foug. **2**: 103, and in 1852 * as *Platycerium grande* Presl, Epim. Bot. 154.

* [According to J. Müller (Muell.-Arg.) in De Candolle's *Prodromus* (15^2: 258. 1862), Presl's *Epimeliae Botanicae*, although bearing the title-page date 1849, was not published until 1852; and as negative evidence, in favor of Müller's assertion, may

In 1845 Fée (Mém. Foug. **2**: 102–104) took up the genus *Nevroplatyceros* from Plukenet and recognized four species, viz.:

N. alcicornis, *N. aethiopicus* Pluk. (*Acrostichum Stemaria* Beauv.), *N. grandis* and *N. biformis*. The first three were placed in the § *Platyceria* and the last named in the § *Scutigera*. A fine plate (*pl. 64*) was given of the second species.

In 1864 Hooker (Sp. Fil. **5**: 282–285) again recognized *Platycerium* with species as follows:

1. *P. alcicorne* Desv.
2. *P. aethiopicum* Hook.
3. *P. grande* J. Sm.
4. *P. Wallichii* Hook.
5. *P. biforme* Bl.

In this somewhat tedious recital we can see from our present viewpoint that during the first half of the last century there were two somewhat common species, the one from Australia with narrow leaves which are usually twice forked and bear the sporangial surfaces on the distal lobes, the other with a broader leaf and usually shorter lobes, bearing the sporangial surface at the extremity of the broadened surface between the lobes. The first, which is the *Platycerium alcicorne* of recent authors, was first described by Cavanilles as *Acrostichum bifurcatum* (type locality, Port Jackson, Australia) and again by Desvaux as *Platycerium angustatum*. Presl recognized this as a distinct species but was unfortunate in the selection of his name, although he specifies that it was the *P. alcicorne* of Gaudichaud and not of previous authors. The second species is from Madagascar and other parts of Africa, where it is the more common species, and was probably the original *Acrostichum alcicorne* Willem. (type locality, Madagascar), and was certainly the *Acrostichum Stemaria* of Beauvois. It is more than likely that a young sterile and possibly abnormal leaf of this species served for the figure of Plukenet which was copied by Schkuhr a hundred years later.

It is, therefore, evident that the name *alcicorne*, which Swartz and his contemporaries used to include both plants, and which

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be noted the fact that Presl's work was reviewed by Schlechtendahl as a novelty in the Botanische Zeitung, in September 1852 (**10**: 656, 657). Internal evidence that the final touches were not given to Presl's manuscript until after the close of the year printed on his title-page, is to be found in two direct citations, on page 261, of species published by Kunze in 1850 (Bot. Zeit. **8**: 57, 58. 25 Ja 1850). Finally, an inspection of the original paper cover of the *Epimeliae* shows that it is dated (on last page) "Pragae, 1851." —— J. H. B., ED.]

later authors with more or less precision, commencing with Gaudichaud and Presl, have used for the Australian species, does not belong with it, and that only with doubt can *Acrostichum alcicorne* Willem., in the absence of its type, be referred to any species known to-day. The overwhelming probability, however, points to it as being the same as *Acrostichum Stemaria* Beauvois.

With these modifications of existing nomenclature we proceed to an enumeration of the species, of which there appear to be thirteen known at the present time; of these eight species are in cultivation at the Royal Botanical Garden at Kew, and seven species at the New York Botanical Garden. Three species we have seen only in herbarium collections, and there is only one (*A. sumbawense*) which we have not seen in some form.

Synopsis of the species of Alcicornium *

Sporophyls broad, with no narrow strap-like divisions.
  Sporophyls rounded at the apex, with entire or repand margins; sporangial area oval; basal leaves erect. — 2. *A. angolense.*
  Sporophyls more or less lobed at the apex.
    Apex with two rounded lobes; margins otherwise entire; sporangial areas reniform. — 5. *A. Ellisii.*
    Apex with irregular margins showing manifest tendency to fork; sporangial areas irregular in shape following the outline of the leaf; basal leaves thick, with deep irregular pits when dry. — 8. *A. madagascariense.*
Sporophyls with narrow strap-like lobes, in shape resembling a stag's horn.
  Sporangial areas on a stalked scutiform disc. — 4. *A. coronarium.*
  Sporangial areas on the surface of the sporophyl.
    Sporangial areas at or below the forks and not on the strap-like lobes of the leaf.

* We add here the original description of the only species not seen:

"*P. sumbawense* n. sp. Christ.

Inter P. alcicorne Desv. et P. Wallichii Hook. habitu intermedium, sed omnium angustissimum. Frondibus fertilibus pallidis binis, ternis sive quinis, ligulatis loriformibus, ad basin sensim attenuatis, 65 cm longis, parte latissima 3 cm latis, sulcato-nervosis, adpresse floccosis, media circiter longitudine dichotomo-divisis, atque iterum bis dichotomis, segmentis ultimis furcatis (laciniis ultimis usque ad 20 pro fronde) lanceolato-triangularibus rostratis, involutis, 7 ad 6 cm longis obtusiusculis, omnibus soriferis, soris faciem inferiorem usque ad basin laciniarum omnino tegentibus, immature pube densa albida obtectis, mature rufis partim ista pube tectis. Frondibus sterilibus, politis nitidis scariosis fragilibus spongiosis ochraceo-fulvis reniformi-rotundatis 15 ad 30 cm diametro, margine laciniatis laciniis profundis furcatis. Nervis conspicuis areolas elongatas angulosas formantibus, nervulis aliquot lateralibus liberis inclusis.

Differt a P. alcicorni lamina magis decomposita, angusta, segmentis multo minoribus, rostratis, numerosis. Differt a P. Wallichii statura multo minore, omnibus partibus angustioribus, et soris terminalibus nec in sinu ramorum positis." Warburg, Monsunia 1: 64. 1900.

Sporangial area on an enlarged basal portion of the sporophyl. 6. *A. grande.*
Sporangial area at the sinus of the second fork of the sporophyl.
Basal leaves laciniate into strap-shaped lobes; sporangial areas oval, on a modified portion of the sporophyl. 12. *A. Wallichii.*
Basal leaves undulate or entire at the margins; sporangial area triangular, on the unmodified surface of the sporophyl. 9. *A. Stemaria.*
Sporangial areas on the narrow strap-like lobes of the sporophyl, only exceptionally extending below the sinus.
Sporophyls rigid, erect in growth, gradually widening upwards and then forming several lobes or divisions.
Bright-green both sides; sporangia-bearing divisions broad (5–8 cm.). 7. *A. Hillii.*
White both sides but becoming greenish above from the deciduous stellate scales; sporangia-bearing divisions narrow (2.5 cm. or less wide). 11. *A. Veitchii.*
Sporophyls lax, pendent in growth.
Sporangial areas on or near the apices of the lobes. (Species of the Old World).
Basal leaves erect and foliaceous; sporophyls many times forked. 13. *A. Willinckii.*
Basal leaves remaining flat and disc-like; leaves 2–3 forked. 3. *A. bifurcatum.*
Sporangial areas medial on the sporophyls. (Andine species.) 1. *A. andinum.*

1. **Alcicornium andinum** (Baker)

Platycerium andinum Baker, Ann. Bot. **5**: 496. 1891; New Ferns 113. 1892. (Type from Peru, *Spruce 4729.*)

RANGE: Mountains of Peru and Bolivia, first collected by Spruce. The only American species known; strangely confused by Hooker with *A. bifurcatum.*

2. **Alcicornium angolense** (Welw.)

Platycerium angolense Welw.; Hooker & Baker, Syn. Fil. 425. 1868. (Type from Angola, *Welwitsch.*)

Platycerium Elephantotis Schweinf. Bot. Zeitung **29**: 361. *fig.* 1878. (Type from central Africa.)

RANGE: Tropical Africa.

ICON.: Gard. Chron. III. **23**: 155. *f. 62.* 1898; Rev. Hort. Belge **28**: 85. *pl.* 1902; Schweinfurth *loc. cit.*

Schweinfurth's wood cut illustration is very misleading and does not at all compare with his specimens at Kew, which differ in no particular from *A. angolense.*

3. **Alcicornium bifurcatum** (Cav.)

Acrostichum bifurcatum Cav. Anal. Hist. Nat. **1**: 105. 1799. (Type from Port Jackson, Australia.)

Platycerium angustatum Desv. Mem. Linn. Soc. Paris **6**: 213. 1827. (Type from Australia.)

Acrostichum alcicorne R. Br. and *in parte minore* of Swartz and Willdenow. Not *A. alcicorne* Willem.

Platycerium alcicorne of Gaudichaud and Presl.

RANGE: Australia, Lord Howe Island, New Caledonia; possibly extending to Africa, but exact data are wanting.

ICON.: Turpin, Dict. Hist. Nat. (Atlas); Bot. Register **3**: *pl. 262, 263.*

4. **Alcicornium coronarium** (Müller)

Osmunda coronaria Müller, Naturforscher **21**: 107. *pl. 3.* 1785. (Type from Siam.)

Acrostichum biforme Sw. Jour. für die Bot. (Schrader) **1800**[2]: 11. 1801.

Platycerium coronarium Desv. Mém. Linn. Soc. Paris **6**: 213. 1827.

Platycerium biforme Blume, Fl. Jav. Fil. 44. *pl. 18.* 1829.

Nevroplatyceros biformis Fée, Mém. Foug. **2**: 104. 1844–5.

RANGE: East Indies from Siam to Penang, Singapore, Sumatra, Borneo and the Philippines.

ICON.: Müller *loc. cit.*; Blume *loc. cit.*; Beddome, Ferns of Brit. India *pl. 224.*

5. **Alcicornium Ellisii** (Baker)

Platycerium Ellisii Baker, Jour. Linn. Soc. **15**: 421. 1876. (Type from Madagascar, *Ellis.*)

RANGE: Known only from central Madagascar.

ICON.: Baker, Hook. Ic. Pl. **17**: *pl. 1695.*

6. **Alcicornium grande** (J. Sm.)

Platycerium grande J. Sm. Jour. Bot. (Hooker) **3**: 402.

1841 (*nomen nudum*); Presl, Epim. Bot. 154. 1852.* (Type from the Philippines.)

Nevroplatyceros grandis Fée, Mém. Foug. **2**: 103. 1845.

RANGE: East Indies from Singapore to North Borneo and the Philippines; also Moreton Bay, Australia.

ICON.: Hooker, Gen. Fil. *pl. 80 B* (as *Pl. biforme*); Hooker, Fil. Exot. *pl. 86;* Beddome, Ferns of Brit. India *pl. 326;* Gard. Chron. III. **28**: 433. *f. 134.*

7. **Alcicornium Hillii** (Moore)

Platycerium Hillii Moore, Gard. Chron. II. **10**: 429. *f. 74–75.* 1878. (Type from Queensland, *Hill.*)

RANGE: Known only from Queensland, Australia.

ICON.: Moore *loc. cit.*

8. **Alcicornium madagascariense** (Baker)

Platycerium madagascariense Baker, Jour. Linn. Soc. **15**: 421. 1876. (Type from Madagascar, *Pool.*)

RANGE: Known only from Madagascar, the type locality.

9. **Alcicornium Stemaria** (Beauv.)

Neuroplatyceros aethiopicus, nervosis foliis, cornu cervinum referentibus. Pluk. Amal. Bot. 151. *pl. 429. f. 2.* 1705.

? *Acrostichum alcicorne* Willemet, Usteri Ann. 6^{18}: 61. 1796. (Type from Madagascar, *Stadtmann.*)

Acrostichum Stemaria Palisot de Beauvois, Fl. d'Oware et de Benin 2. *pl. 2.* 1804. (Type from Madagascar, *Commerson.*)

Platycerium Stemmaria Desv. Mém. Linn. Soc. Paris **6**: 213. 1827.

Nevroplatyceros aethiopicus Fée, Mém. Foug. **2**: 103. *pl. 64.* 1845.

Platycerium aethiopicum Hook. Garden Ferns *pl. 9.* 1861.

Acrostichum alcicorne of Swartz and Willdenow *pro parte majore.*

RANGE: Tropical Africa from Madagascar to Fernando Po, and north to Sierra Leone.

ICON.: Plukenet *loc. cit.;* Beauvois *loc. cit.;* Fée *loc. cit.;* Hooker, Garden Ferns *pl. 9;* J. Sm. Hist. Fil. *pl. 5.*

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* See footnote on page 590.

10. **Alcicornium sumbawense** (Christ)

Platycerium sumbawense Christ, in Warburg, Monsunia **1**: 64. 1900. (Type from Sumbawa, *Warburg 17266*.)

RANGE: Known only from its type.

This species is possibly not distinct from *A. Willinckii*, so far as one can judge by the description (*q. v.*, page 592, note).

11. **Alcicornium Veitchii** sp. nov.

Platycerium Veitchii Gard. Chron. III. **19**: 652. 1896; Jour. Roy. Hort. Soc. **20**: lxxxiii. 1896 (*nomen nudum*).

Basal leaves appressed, soon becoming brownish; spore-bearing leaves cespitose (up to 11 in the cluster), 60 cm. or more long, narrow at the base, tapering gradually to a width of 5–10 cm. or more, then dividing into 6–8 narrow pseudopalmate lobes, 10–20 cm. long by 2–2.5 cm. wide, all becoming more or less sporangiferous in irregular areas; upper surface grayish-scurfy from the quantities of stellate hairs which soon become loosened, finally smoothish in irregular areas from these hairs becoming deciduous; under surface clear white from the abundant, crowded, silvery, star-like matted hairs.

Imported from Adelaide, Australia with other plants by Messrs. Veitch, the horticulturists for whom the species is named, and by them publicly exhibited in 1896. Described from living plants in hort. Kew, September, 1905.

A very distinct species of rigid habit quite in contrast with the other Australian members of the genus.

12. **Alcicornium Wallichii** (Hook.)

Platycerium Wallichii Hook. Gard. Chron. **1858**: 764. 1858.

RANGE: India (type from the banks of the Irawaddy, *Wallich*).

ICON.: Hooker, Fil. Exot. *pl. 97;* Beddome, Ferns of British India *pl. 108*.

13. **Alcicornium Willinckii** (Moore)

Platycerium Willinckii Moore, Gard. Chron. II. **3**: 302. *f. 56.* 1875.

RANGE: Java (type from Java, whence it was introduced to cultivation by Willinck about 1873).

ICON.: Moore *loc. cit.;* Garden **10**: 383. *f.* 1876.

COLUMBIA UNIVERSITY.

Studies on the Rocky Mountain flora — XV

Per Axel Rydberg

In preparing my Flora of Colorado, to be issued as a Bulletin from the Agricultural College at Fort Collins, Colorado, and now in press, I have found it necessary to change the nomenclature of a number of species. As the scope of the Flora comprises only keys to the families, genera and species, and an enumeration of localities where specimens have been collected, it has been impossible to include therein any fuller synonomy with citations, or any discussions. It has, therefore, seemed advisable to make the publication of these changes and notes elsewhere.

Caryopitys monophylla (Torr. & Frém.) Rydb.

Pinus monophyllus Torr. & Frém. Rep. 319. 1845.

Dr. Small in his Flora of the Southeastern United States has followed the more modern views in dividing genera, which consist of very natural sections or subgenera, into as many separate genera. The genus *Pinus* as usually treated contains at least four distinct subgenera, better defined and more easily distinguished from each other, than for instance *Picea* and *Tsuga*. Three of these had already generic names, *viz.: Pinus* L. (proper), *Apinus* Necker and *Strobus* Opiz. Dr. Small had to give the fourth group, which is wholly American, a new name, *Caryopitys*. In the Rocky Mountain region the genus is represented by the type species *C. edulis* (Engelm.) Small, and by the species given above. One of the four genera is not represented within the area covered by Dr. Small's work, *viz.:*

Apinus Necker, Elem. Bot. **3**: 269. 1790

Most of Necker's genera are hard to determine, but in this case Necker not only gives the characters by which he distinguishes the genus from *Pinus* proper, but also cites two species, *viz.: cembra* and *pinea*. In the Kew Index, the genus is given, but no species are mentioned. The way in which Necker makes his statement, there is all the reason to claim that the two species are there published as *Apinus*. Necker states that *Larix* contains 3 species, *viz.: decidua, cedrus* and *strobus; Pinus* 2, *sylvestris* and *taeda: Apinus* also 2, *viz.: cembra* and *pinea*, but *Abies* 5, etc. If Necker had meant that these were the Linnaean species of *Pinus* to be distributed among the different genera, he would have stated it differently. There was no *Pinus decidua* L., but a *Pinus Larix* L. and a *Larix decidua* Miller. *Apinus* is most related to *Strobus*, but differs in the thick cone-scales, the erect or horizontal instead of pendent cone and a very hard-shelled seed with only a vestige of a wing. In the Rocky Mountains, it is represented by the two following species:

Apinus flexilis (James) Rydb.

Pinus flexilis James, in Long's Exped. **2**: 34. 1823.

Apinus albicaulis (Engelm.) Rydb.

Pinus albicaulis Engelm. Trans. Acad. St. Louis **2**: 209. 1863.

Sabina utahensis (Engelm.) Rydb.

Juniperus californica utahensis Engelm. Trans. Acad. St. Louis **3**: 588. 1877.

Haller's genus *Sabina* is also one just as consistently taken up by Dr. Small. I shall here give only the Rocky Mountain species to be referred to this genus.

Sabina monosperma (Engelm.) Rydb.

Juniperus occidentalis monosperma Engelm. Trans. Acad. St. Louis **3**: 590. 1877.

Sabina Knightii (A. Nels.) Rydb.

Juniperus Knightii A. Nels. Bot. Gaz. **25**: 198. 1898.

Sabina scopulorum (Sargent) Rydb.

Juniperus scopulorum Sargent, Garden and Forest **10**: 420. 1897.

Sparganium multipedunculatum (Morong) Rydb.

Sparganium simplex multipedunculata Morong, Bull. Torrey Club **15**: 79. 1888.

This is quite distinct from *S. simplex* L. To the characters given by the late Dr. Morong may be added the broad scarious margins of the leaf-sheaths. This character it has in common with *S. americanum* Nutt. of the eastern United States and *S. subvaginatum* Meinsh. of Europe. In fact, Meinshausen included C. C. Parry's plant from Colorado in the latter. It is, however, very doubtful if it belong there, for the original description of *S. subvaginatum* does not fit our plant very well. *S. multipedunculatum* ranges from the Mackenzie River and Washington to Colorado.

Potamogeton Richardsonii (Bennett) Rydb.

Potamogeton perfoliatus lanceolatus Robbins, in A. Gray, Man. ed. 5. 488. 1867. Not *P. perfoliatus lanceolatus* Blytt. 1861.

Potamogeton perfoliatus Richardsonii Bennett, Jour. Bot. **27**: 25. 1889.

Our common North American plant does not seem to intergrade at all with the true *P. perfoliatus* L.

✓**Stipa Porteri** Rydb.

Stipa mongolica (Thurber, in A. Gray, Proc. Acad. Phila. **1863**: 79, hyponym. 1863.) Port. & Coult. Syn. Fl. Colo. 145. 1874. Not *S. mongolica* Turcz.

In the enumeration of Hall and Harbour's plants, Thurber determined this plant as *S. mongolica* Turcz., which is evidently erroneous. He gives the name and a short discussion but no description. A good description was afterwards given by Porter and Coulter in the Synopsis of the Flora of Colorado.

✓ **Muhlenbergia cuspidata** (Torr.) Rydb.

Vilfa cuspidata Torr.; Hook. Fl. Bor. Am. **2**: 238. 1839.

Sporobolus cuspidata Wood, Bot. & Fl. 385. 1870.

The group of grasses, which Torrey, Trinius and Thurber regarded as a good generic type and for which they adopted the name *Vilfa*, is altogether out of place in the genus *Sporobolus*, where its species have been placed by authors. They are no "Drop-seed" grasses at all, the grain remaining enclosed in the firm flowering glume. They should be taken out of *Sporobolus*, but if they should constitute a genus by themselves is questionable. The generic name *Vilfa* is not available, for the type of *Vilfa* Adans. is apparently a species of *Agrostis*. As there is no character, whatever, to separate these plants from *Muhlenbergia* as now limited, the only rational way to treat them at present is to transfer them all to *Muhlenbergia*. At any rate, they are congeneric with *M. Wrightii* Vasey, slender specimens of which are very hard to distinguish from *M. cuspidata* here proposed. The other Rocky Mountain species are:

Muhlenbergia Richardsonis (Trin.) Rydb.

Vilfa Richardsonis Trin. Mem. Acad. St. Petersb. VI. Nat. **5**[2]: 103. 1840.

? *Agrostis brevifolia* Nutt. Gen. **1**: 44. 1818.

The specific name *brevifolia* may have to be taken up for this species, but it is doubtful if *Agrostis brevifolia* is a synonym of this. Professor Scribner claims that it belongs to the preceding species. What *Vilfa Richardsonis* Trin. is, is not doubtful, and that specific name is therefore preferable.

Muhlenbergia simplex (Scribn.) Rydb.

Sporobolus simplex Scribn. Bull. U. S. Div. Agrost. **11**: 48. 1898.

Muhlenbergia filiformis (Thurber) Rydb.

Vilfa depauperata filiformis Thurb.; S. Wats. Bot. King's Expl. 376. 1871.

Vilfa gracillima Thurb. Bot. Calif. **2**: 268. 1880. Not *Muhlenbergia gracillima* Torr. 1856.

Sporobolus filiformis Rydb. Contr. U. S. Nat. Herb. **3**: 189. 1895.

Muhlenbergia aristulata Rydb.

Sporobolus aristatus Rydb. Bull. Torrey Club **28**: 266. 1901. Not *Muhlenbergia aristata* Pers. 1805.

Muhlenbergia Wolfii (Vasey) Rydb.

Vilfa minima Vasey, Bot. Wheeler Surv. 282. 1878. Not *V. minima* Trin. 1855.

Sporobolus Wolfii Vasey, Bull. Torrey Club **10**: 52. 1883.

Muhlenbergia Thurberi Rydb.

Sporobolus filiculmis Vasey; Beal, Grasses N. Am. **2**: 288. 1896. Not *S. filiculmis* Dewey. 1894.

Vilfa filiculmis Thurber; Beal, *l. c.*, as a synonym.

Both *Sporobolus filiculmis* Vasey and *Vilfa filiculmis* Thurber appeared in 1885 in Vasey's Catalogue of the Grasses of United States, on page 44; but both are there nomina nuda and the first place where a description is published is, as far as I can find, in Beal's Grasses of North America. In the meantime Dewey had published another *Sporobolus filiculmis* which invalidates that specific name.

Sporobolus flexuosus (Thurber) Rydb.

Sporobolus cryptandrus flexuosus Thurber; Vasey, Bot. Wheeler Surv. 282. 1878.

This is evidently specifically distinct from *S. cryptandrus.*

Deschampsia alpicola Rydb. sp. nov.

Deschampsia caespitosa alpina Vasey; Beal, Grasses N. Am. **2**: 368; at least in part. 1896. Not *D. alpina* R. & S. 1817.

Densely cespitose, tufted perennial; sterile shoots numerous; sheaths 2–3 cm. long, glabrous, striate; ligules linear-lanceolate, acuminate, about 5 mm. long; blades 1–2 dm. long, 1–2 mm. wide, stiff, often more or less involute; culm-leaves with sheaths 1–1.5 dm. long and blades 1–4 cm. long; culms 3–5 dm. high; panicle short, open, 8–15 cm. long, its branches in 2's to 5's, 3–6 cm. long, soon spreading; spikelets about 5 mm. long; empty glumes about 4 mm. long, lanceolate, acute; flowering glume nearly as long, hirsute at the base; awn attached one third or one-fourth from the base, one and a half to two times as long as the glume, bent and twisted.

This differs from *D. caespitosa* in the large flowers and the long awns. It has been mistaken for *D. bottnica*, but that species has long narrow inflorescence and comparatively longer empty glumes. *D. alpicola* is rather common in alpine regions of Colorado. A similar if not identical form is also found in Alaska. As the type may be designated:

COLORADO: Mountain meadows, Pike's Peak, Sept. 4, 1901, at an altitude of 3600 meters, *L. M. Underwood XX.*

Graphephorum Shearii (Scribn.) Rydb.

Trisetum argenteum Scribn. Bull. U. S. Div. Agrost. **11**: 49. 1898. Not *T. argenteum* R. & S. 1817.

Trisetum Shearii Scribn. Circ. U. S. Div. Agrost. **30**: 8. 1901.

Professor Scribner has merged *Graphephorum* into *Trisetum*. I think, though, that they should be retained as two distinct genera, even if the former should be transferred to the tribe *Aveneae*.

Distichlis stricta (Torr.) Rydb.

Uniola stricta Torr. Ann. Lyc. N. Y. **1**: 155. 1824.

Distichlis maritima stricta Thurber, Bot. Calif. **2**: 306. 1880.

Distichlis spicata stricta Scribn. Mem. Torrey Club **5**: 51. 1894.

Eatonia robusta (Vasey) Rydb.

Eatonia obtusata robusta Vasey; Beal, Grasses N. Am. **2**: 493. 1896.

To the characters given in the original description should be added: intermediate nerves of the second glume very strong, and leaf-blades firm, much broader than the sheaths, and therefore forming distinct auricles at the base. The nerves mentioned are in this species almost as prominent as the lateral nerves. In *E. obtusata* they are faint, while the lateral ones are very prominent.

Eatonia intermedia Rydb. sp. nov.

Culm 6–8 dm. high, 1.5–2.5 mm. thick, striate, shining; sheaths 5–15 cm. long, striate, minutely scabrous; ligules about 2 mm. long, truncate, erose and often cleft; blades 8–15 cm. long, 3–5 mm. wide, usually flat, broader than the sheaths and therefore forming distinct auricles at the base; inflorescence rather narrow and dense, 8–15 cm. long, 1–3 cm. wide; spikelet usually 2-flowered; first empty glume about 2 mm. long, subulate, scabrous on the back; second empty glume oblanceolate in side view, rather firm, slightly scarious on the margin, with prominent scabrous nerves, obtusish, about as wide as the flowering glumes, a little over 2 mm. long and 0.5 mm. wide; flowering glume oblong-lanceolate in side-view, rather firm, with faint nerves and minutely scabrous; palate narrowly linear, scarious.

This species has been named both *E. obtusata* and *E. pennsylvanica*, and is intermediate between the two. From the former it differs in the narrower second glume, which is scarcely broader than the flowering glume and neither truncate nor cucullate at the apex; from *E. pennsylvanica* it differs in the denser inflorescence and the firmer and less acute second glume, which has the texture of that of *E. obtusata*. In *E. pennsylvanica* the second empty glume is thin, very acute and with a broad scarious margin.

A few of the specimens to be referred to this are given here:

MONTANA: East Gallatin Swamps, July 24, 1896, *P. A. Rydberg 3174* (type) and *3173;* Columbia Falls, 1893, *R. S. Williams;* Blue Cloud, near Helena, 1887, *F. D. Kelsey.*

COLORADO: Gunnison, 1901, *C. F. Baker 524;* Pagosa Springs, 1899, *Baker 169;* Durango, 1898, *Baker, Earle & Tracy 950* (the last determined as *Agrostis exarata*).

Poa callichroa Rydb. sp. nov.

Perennial with a horizontal rootstock, but more or less matted; culm about 3 dm. high, mostly leafy at the base; sheaths strongly striate, 2–10 cm. long; ligules lanceolate or ovate, acute, about 3 mm. long; blades of the lower leaves 6–10 cm. long, 3–4 mm. wide, firm, dark-green, strongly veined; blades of the upper leaves about 3 cm. long, erect; panicle 6–9 cm. long, open; branches mostly in 3's or 4's below, the lowermost 2–3 cm. long; spikelets 6–8 mm. long, 5–7-flowered; empty glumes lanceolate in side-view, about 5 mm. long, acuminate, purple with greenish or brownish margins; flowering glumes 4–5 mm. long, lanceolate, acuminate, with strong nerves, green below, then purple, then brown, and white and scarious above; nerves and internerves more or less villous; cobweb at the base present but scant.

This species is a relative of *P. arctica* and *P. cenisia*, but differs from both in the taller habit, broader leaves and larger, 5–7-flowered (instead of 3–4-flowered) spikelets.

COLORADO: Dead Lake, near Pike's Peak, August 14, 1901, *F. E. & E. S. Clements 457.*

Poa pudica Rydb. sp. nov.

Perennial with a short rootstock and often tufted; culm 2–3 dm. high; lower leaves with short sheaths, which are often rather loose; ligules truncate, about 2 mm. long; blades 4–5 cm. long, usually conduplicate, strongly nerved; sheaths of the stem-leaves 5–7 cm. long; blades 2–4 cm. long, erect; panicle 4–8 cm. long, open; branches usually in pairs, in age reflexed; the lowest 4–5 cm. long, bearing the spikelets near the ends; spikelets 4–5 mm. long, mostly 3-flowered; empty glumes lanceolate in side view, strongly veined, usually purple, acuminate; flowering glumes lanceolate, sharp-acuminate, greenish below, then purplish and scarious at the apex; cobweb present but scant; internerves glabrous and nerves pubescent.

The type specimens were determined by Professor Scribner as *P. arctica*, but it differs from that species in the smaller more sharply acuminate flowering glumes and their glabrous internerves. These characters would place it closer to *P. reflexa*. The latter species is, however, taller, and the intermediate nerves of the flowering glumes are glabrous.

COLORADO: Stephen's Mine, below Gray's Peak, Aug. 23, 1895, *P. A. Rydberg 2443* (type); near Pagosa Peak, Aug. 1899, *C. F. Baker 209* (determined as *P. reflexa*); high mountains about Empire, 1892, *H. N. Patterson 272*.

Poa macroclada Rydb. sp. nov.

Perennial with a horizontal rootstock; culm 6–8 dm. high; sheaths 5–15 cm. long, rather loose, strongly striate, slightly scabrous; ligules ovate, acute, about 2 mm. long; leaf-blades 7–10 cm. long, 2 mm. or less wide, flat, glabrous, firm and dark-green; panicle 2–3 dm. long, open; branches in 3's–5's, in fruit reflexed or spreading, the lower often 1 dm. long, with the spikelets near the ends; spikelets often about 5 mm. long, 2- or 3-flowered; empty glumes lanceolate, very acute, more or less purplish; flowering glume lanceolate, acute or acuminate, glabrous, slightly purple-tinged; intermediate veins faint and cobweb scant.

This species is related to *P. aperta*, but differs in the long slender branches of the panicle and the glabrous flowering glumes.

COLORADO: Roger's, Gunnison Watershed, August 14, 1901, *C. F. Baker 802*.

Poa interior Rydb. sp. nov.

Poa nemoralis Scribn. Bull. U. S. Div. Agrost. **17**: 250. 1899. Not *P. nemoralis* L. 1753.

? *Poa caesia* Coult. Man. Rocky Mt. Reg. 421. 1885. Not *P. caesia* Smith. 1800.

The grass common throughout the Rocky Mountain region and extending in the north from Alaska to the Dakotas and generally known as *P. nemoralis* is quite different from the European plant. The latter is found in America as sparingly introduced in the Eastern States. The European plant is taller, with soft, flaccid leaves, ovate or lanceolate acute ligules, larger spikelets and narrowly lanceolate empty glumes which are tapering gradually at the apex and much narrower than the flowering glumes. The American plant is usually lower and stiffer, has rather firm leaves, truncate ligules, smaller spikelets, broader empty glumes, which are rather abruptly acuminate and at least the second almost as broad as the flowering glumes. The name *P. nemoralis* was used for the American plant by Hooker and Arnott,* but appears there without a description. It was adopted by several authors on western botany; but, as far as I know, never described under that name, until 1899 by Professor Scribner. His description and plate illustrates the American rather than the European plant. As the type may be designated:

WYOMING: Headwaters of Clear Creek and Crazy Woman River, 1900, *Frank Tweedy 3706*.

Poa phoenicea Rydb. sp. nov.

Perennial with a horizontal rootstock and extravaginal innovations; culm 5–6 dm. high, leafy; sheaths loose, 5–15 cm. long, striate; ligules triangular-lanceolate or ovate, acute, about 5 mm. long; blades 1–2 dm. long, about 2 mm. wide, rather firm, strongly veined; panicle 6–10 cm. long, open, its branches mostly in pairs, the lower 5–6 cm. long; spikelets 4–5-flowered, 6–7 mm. long; empty glumes lanceolate, acuminate, purple or green below and purple above, glabrous and shining; flowering glumes lanceolate, green at the base, purple in the middle and brownish-scarious at the top; both nerves and internerves villous; cobweb none; intermediate nerves very faint.

This species resembles somewhat *P. pseudo-pratensis*, *P. epilis* and *P. purpurascens* Vasey (see below). From the first it differs by the more acuminate glumes, the faint intermediate nerves of the flowering glumes and the longer, narrower leaves; from the other two by the open inflorescence, the villous, not scabrous flowering glumes and the creeping rootstock.

COLORADO: Pike's Peak Valley, Aug. 21, 1901, *F. E. & E. S. Clements 466*.

* Bot. Beech. Voy. 132. 1832.

Poa subpurpurea Rydb. nom. nov.

Poa purpurascens Vasey, Bot. Gaz. 6: 297. 1881. Not *P. purpurascens* Sprengel. 1819.

Poa tricholepis Rydb. sp. nov.

Perennial with a creeping rootstock and extravaginal innovations; sheaths of the basal leaves short, 2–4 cm. long, strongly striate, rather loose, minutely retrorse-striate; blades 5–10 cm. long, a little over 1 mm. wide, scabrous; sheaths of culm-leaves 7–12 cm. long; blades 2–6 cm. long, sometimes nearly 2 mm. wide; ligules lanceolate, acuminate, about 4 mm. long; culm slender, 3–5 dm. high; panicle 6–8 cm. long, open, its branches in pairs, 2–3 cm. long; spikelets 3–4-flowered, 5–8 mm. long; empty glumes about 4 mm. long, lanceolate in side view, acute, green and purple towards the apex; flowering glumes about 4 mm. long, villous below, strigose above, green, bordered with purple and a scarious border, obtuse.

This is related to *P. Wheeleri* and *P. Vaseyana*, but is easily distinguished from both by the obtuse flowering glume, which is villous below. In the two species mentioned the flowering glume is very acute and strigulose or scabrous throughout, or in *P. Vaseyana* hairy on the nerves only.

COLORADO: Near Pagosa Peak, Aug. 1899, *C. F. Baker 210*.

Poa nematophylla Rydb. sp. nov.

A cespitose bunch-grass; basal leaf-blades short, striate, minutely retrosely strigulose; stipules lanceolate, acuminate, about 3 mm. long; blades 1–1.5 dm. long, filiform, strongly involute, less than 0.5 mm. wide, scabrous-strigulose; culm-leaves few, near the base; sheaths 4–6 cm. long; blades 3–5 cm. long; culm about 3 dm. high, filiform; inflorescence narrow, raceme-like, 2–5 cm. long; branches 2–10 mm. long, bearing often only a single spikelet; spikelets 7–9 mm. long, about 4-flowered; empty glumes about 4 mm. long, lanceolate, glabrous and shining; flowering glumes about 6 mm. long, light-green, with a silvery scarious margin, very acute, strigose below, scabrous-strigulose above.

Related to *Poa idahoensis*, but distinguished by the narrow inflorescence and few racemosely disposed spikelets.

COLORADO: Meeker, Rio Blanco County, June 8, 1902, *G. E. Osterhout 2601*.

Poa confusa Rydb. sp. nov.

A tufted bunch-grass with intravaginal innovations; sheaths of the basal leaves short, striate, glabrous; blades 1–2 dm. long, 2–3 mm. wide, flat or involute, puberulent; culm-leaves several; sheaths 1–1.5 dm. long; blades about 1 dm. long; ligules broadly ovate or rounded, obtuse or acutish, about 2 mm. long; culm 6–9 dm. high; panicle narrow, 1–1.5 dm. long, dense; branches short, strongly ascending; spikelets 7–8 mm. long, usually 4-flowered; empty glumes lanceolate in side-view, shining, minutely strigulose above; flowering glumes narrow, about 3.5 mm. long, obtuse or rounded at the apex, rounded on the back below, strigulose, yellowish-green with brownish scarious margin.

This species has been confused with *P. laevigata*, *P. lucida* and *P. nevadensis.* It differs from the first two by the short and broad ligules (in both the ligules are lanceolate and acuminate), and from the last by the empty glumes and in being scarcely scabrous. In *P. nevadensis* the empty glumes are strongly nerved, elongated-lanceolate, almost equaling the oblong, very scabrous flowering glumes; in *P. confusa* they are faintly nerved, broadly lanceolate, shorter than the flowering glumes. *P. confusa* grows in open "parks" and on hills from Nebraska and Montana to Colorado. As the type may be assigned:

WYOMING: Medicine Bow Mountains, Albany County, July 28, 1900, *Aven Nelson 7787.*

Poa truncata Rydb. sp. nov.

A species related to the preceding but stiffer; basal leaves withering early; sheaths of culm-leaves 10–15 cm. long, with conspicuous hard auricles at the mouth; ligules very short, about 1 mm. long, truncate; blades 1–2 dm. long, 2–3.5 mm. wide, scabrous on the back; culm about 9 dm. high, stiff; panicle about 1.5 dm. long, narrow, with almost erect scabrous branches; spikelets 3–5-flowered, 7–9 mm. long; empty glumes 5–6 mm. long, tinged with purple, scabrous on the nerves; flowering glumes narrow, about 5 mm. long, straw-colored or tinged with purple, strigulose throughout and slightly scabrous on the veins.

The short truncate ligules separate this from the preceding and all other related species.

COLORADO: Dillon, Summit County, August 26, 1896, *F. E. Clements 373.*

Festuca Earlei Rydb. sp. nov.

Perennial with rootstocks and extravaginal innovations; basal leaves with short ligules; blades filiform, 5–10 cm. long, strongly involute, 0.5 mm. wide or less; sheaths of the culm-leaves 3–5 cm. long, striate, smooth; ligules very short, truncate; blades 3–5 cm. long, 1 mm. wide or less; culm about 3 dm. high, very slender; panicle narrow and spike-like, 3–5 cm. long; branches short and erect, smooth; spikelets 2–3-flowered, about 5 mm. long; first empty glume about 2 mm. long, narrowly lanceolate; the second about 3 mm. long, ovate-lanceolate, 3-nerved; flowering glumes narrowly lanceolate, about 4 mm. long, smooth, usually awned; awn 1 mm. or less long.

This species is related to *F. rubra*, but differs in the smaller few-flowered spikelets, the smaller flowering glumes, and the fine, soft leaves.

COLORADO: La Plata Cañon, July 11, 1898, *Baker, Earle & Tracy 920.*

Festuca ingrata (Hack.) Rydb.

Festuca ovina ingrata Hack.; Beal, Grasses N. Am. **2**: 598. 1896.

This is the common plant of the Rocky Mountain region, which has been known under the name *F. ovina.* It is quite different from the European *F. ovina* L. The latter is found in America only in the northeastern part of the continent.

Festuca minutiflora Rydb. sp. nov.

Tufted perennial with intravaginal innovations; leaves mostly basal; sheaths smooth, 1 cm. or so long; ligules 0.75 mm. long, obtuse or rounded at the apex; blades 5–10 cm. long, narrow and flaccid, about 0.5 mm. wide; sheaths of the culm-leaves 2–4 cm. long; blades 1–3 cm. long; culm very slender, 1–1.5 (seldom 3) dm. high; panicle very narrow, lax, 2–4 cm. long, with very short erect branches; spikelets, excluding the awns, about 5 mm. long, 2–3-flowered; first empty glume narrowly lanceolate, 2–2.5 mm. long, acute; the second 2.5–3 mm. long, ovate-lanceolate, short-acuminate or awn-pointed; flowering glume oblong-lanceolate, about 2 mm. long, purple-tinged above, abruptly contracted into a short awn, 1.5 mm. or less.

This is closely related to *F. brachyphylla*, but differs in the smaller spikelets, the more abruptly acuminate flowering glumes, the shorter awns, the laxer panicle and the soft filiform leaves. It grows in alpine situations of Colorado, at an altitude of 3000–4000 meters, and is found apparently also in California.

COLORADO: Cameron Pass, July 13, 1869, *C. F. Baker* (type); near Pagosa Peak, 1899, *Baker 176*; "Colorado," *E. Hall 12*; Mt. Lincoln, *John Wolf*; Tennessee Pass, 1893, *De Alton Saunders*; Mt. Ouray, 1896, *F. E. Clements 210½*; near Manitou, 1896, *Clements 46*.

CALIFORNIA: *Bolander 5066*.

Elymus strigosus Rydb. sp. nov.

A cespitose perennial; sheaths 3–8 cm. long, striate, glabrous or minutely puberulent, with distinct auricles at the mouth; ligules very short, truncate, 1 mm. long or less; blades 1–2 dm. long, about 3 mm. wide, flat or involute, scabrous; culm 5–7 dm. high; spike 1–1.5 dm. long; spikelets 1 or 2 at each node; empty glumes linear-subulate, 7–9 mm. long, very scabrous; flowering glumes lanceolate, scabrous-strigose, awn-pointed or short-awned, without the awn about 1 cm. long.

This is closely related to *E. ambiguus*, but distinguished by the scabrous strigose flowering glumes, the more scabrous empty glumes and the narrower leaves.

COLORADO: Near Boulder, at an altitude of 2300 meters, July 31, 1886, *C. W. Letterman 553* (type, labeled *Agropyrum dasystachyum*).

WYOMING: Naked shale slopes, Point of Rocks, Sweetwater County, 1900, *Aven Nelson 7151* (labeled *Elymus salinus*).

Elymus villiflorus Rydb. sp. nov.

A cespitose perennial; sheaths 4–10 cm. long, striate, glabrous; blades 1–2 dm. long, about 2 mm. wide, strongly involute, scabrous above; culm 4–6 dm. high, finely retrorse-pubescent above; spike 1–1.5 dm. long; spikelets 1 or 2 at each node; empty glumes subulate, 7–9 mm. long; flowering glumes lanceolate, 5-nerved, villous-hirsute, without the short awn about 1 cm. long.

Closely related to the preceding and *E. ambiguus*, this is characterized by its long-haired and more strongly nerved flowering glume. It grows on plains and foothills at an altitude of 1500–1800 meters.

COLORADO: Near Boulder, July, 1902, *F. Tweedy 4818* (type).
ALBERTA: Banff, July 21, 1900, *H. B. Lawson.*

Juncoides intermedium (Thuill.) Rydb.

Juncus intermedius Thuill. Fl. Env. Paris. ed. 2. 178. 1799.
Juncus multiflorus Ehrh.; Hoffm. Fl. Deutschl. ed. 2. **1**: 169. 1800. Not *J. multiflorus* Retz. 1795.

This is the plant that has been known in America under the name *Luzula campestris* or *Juncoides campestre*, but this North European species is found, if at all on this continent, only in the extreme northeastern portion. It is distinguished from *J. intermedium* by its fewer, larger and nodding spikelets. The name *Juncus multiflorus* dates back as far as 1791, when Ehrhart issued his set of grasses, sedges, etc., but as far as can be ascertained, it was never published for this plant before 1800, in the revised edition of Hoffmann's Flora.

Nemexia lasioneuron (Hook.) Rydb.

Smilax lasioneuron Hook. Fl. Bor. Am. **2**: 173. 1838.
Nemexia herbacea melica Aven Nelson, Proc. Biol. Soc. Wash. **17**: 175. 1904.

Ibidium porrifolium (Lindl.) Rydb.

Spiranthes porrifolia Lindl. Gen. & Sp. Orch. 467. 1840.

Mr. House * has shown that *Ibidium* Salisb. is the name that properly should be used for *Spiranthes* Richard and *Gyrostachys* (Pers.) Kuntze; *Ophrys* L. for *Listera* R. Br. and *Cytherea* Salisb. for *Calypso* Salisb. The Rocky Mountain species of these genera, which have not already been transferred, are given here.

Ophrys borealis (Morong) Rydb.

Listera borealis Morong, Bull. Torrey Club **20**: 31. 1893.

Ophrys nephrophylla Rydb.

Listera nephrophylla Rydb. Mem. N. Y. Bot. Gard. **1**: 108. 1900.

Ophrys caurina (Piper) Rydb.

Listera caurina Piper, Erythea **6**: 32. 1898.

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* Bull. Torrey Club **32**: 378–382. 1905.

New plants from Colorado

George E. Osterhout

Allionia sessilifolia sp. nov.

Perennial from the root, the stem rather stout, 5–10 dm. high, erect and branched above, angled, glabrous, but the branches glandular-pubescent above; leaves thickish, all sessile, the lower ovate, 6–8 cm. long, 4 cm. wide, rounded at base, the upper narrower becoming smaller and bract-like; inflorescence spreading, the flowers numerous; involucre hirsute, 3-flowered, the flowers longer than the involucre; stamens about four, exserted; fruit 4–5 mm. long, 5-ribbed, having short ridges between the ribs and at right angles to them.

Allionia sessilifolia seems nearest related to *A. pilosa* (Nutt.) Rydb., but is readily distinguished by the glabrous stem and the broader sessile leaves. Collected at Livermore, Larimer County, Colorado, July 25, 1893, *Osterhout 179*.

Aster fluvialis sp. nov.

Perennial from creeping rootstocks, the stem rather slender, 6–10 cm. high, leafy and branched from near the base, or in shade or crowded vegetation more strict, slightly pubescent in lines; leaves lanceolate, tapering to both ends, sessile, the larger ones 1 dm. long, 1 cm. wide, thin, entire, ciliate on the margins, some of them usually with rare denticulations, becoming much smaller on the leafy panicle; inflorescence much branched and paniculate, the the flowers numerous on the leafy branches; heads 7–10 mm. long, or including the rays 15 mm. long; bracts imbricated in successive lengths of four series, close and erect, narrowly spatulate and green-tipped, scarious-margined; rays varying from light- to dark-purple but never white.

This *Aster* has been referred to *A. longifolius* and to *A. paniculatus* and seems to be nearer the latter, but is manifestly neither of them. The flowers are larger than those of *A. paniculatus*, the rays are never white, the leaves are entire and thinner, and the stem is more branched. It is plentiful along the streams and ditches of the plains bordering the foothills on the eastern side of the mountains, flowering in September.

Type specimens collected along the Cache LaPouder river at New Windsor, Colorado, September 11, 1904, *Osterhout 2941.*

Senecio lanatifolius sp. nov.

Senecio Fendleri lanatus Osterhout, Bull. Torrey Club **31**: 358. 1904. Not *Senecio lanatus* L.

Perennial, 1–2 dm. high, several-stemmed from the root, usually branched, very leafy to the inflorescence; leaves linear, pectinate-pinnatifid, the divisions crenate-toothed with inrolled edges, the upper leaves becoming bract-like; both stem and leaves pannose-canescent; peduncles very short; heads many, crowded, almost 1 cm. long, of about seven glabrous bracts in a single row and about 15 flowers; achenes glabrous; *rays none.*

Collected at Wolcott, Eagle County, Colorado, July 11, 1902, *Osterhout 2667.*

Carduus araneosus sp. nov.

Perennial; stem about 5 dm. high, rather slender, branched from about the middle, having a little light tomentum at the time of flowering; lowest leaves not known; stem-leaves linear, 10–12 cm. long, canescent beneath with a close tomentum, bright-green and glabrous above, pinnatifid, the lobes oblong, each tipped by a moderate spine, decurrent on the stem for 3 cm.; heads solitary on peduncles 5–10 cm. long, usually subtended by a linear elongated leaf; involucral bracts in about three series, the outer series about 1 cm. long, a little more than half the length of the second, both gradually tapering from a base 1 mm. wide to a rigid prickly point, and both long-woolly from the margins, the inner bracts weak-pointed, fimbriate-margined and purple-tinged; flowers whitish; pappus tawny, sparingly plumose.

A species somewhat related to *C. Parryi* (A. Gray) Greene, but a slenderer plant, the leaves more tomentose beneath and decurrent on the stem. Collected at Red Cliff, Eagle County, Colorado, June 26, 1900, *Osterhout 2169.*

Carduus spathulatus sp. nov.

Perennial; stem rather slender, 8 dm. high or more, bearing some slight tomentum at the time of flowering, branched toward the summit; lower leaves spatulate, pointed, 1–2 dm. long, 3–4 cm. wide, remotely serrate and with smaller serrations between the teeth, all pointed with small spines; these succeeded by leaves on winged petioles nearly 1 dm. long, pinnately cleft, the divisions pointed by slender spines, sessile by a clasping base and decurrent on the stem for 1 cm.; all the leaves canescent beneath and with slight tomentum above or glabrous; heads several on leafy peduncles, about 3 cm. high; bracts in 5 series, lanceolate, entire, imbricated in successive lengths, having some webby tomentum on the edges, all tipped with small yellowish spines 5 mm. long, the inner series with somewhat longer but weaker spines, the glandular ridge slight if any; corollas very light-purple or whitish; pappus whitish, plumose, 15 mm. long.

This species is related to *Carduus pulchellus* Greene, but the leaves are much less divided, and the bracts are narrower and the inner not so much elongated. Collected in North Park, Colorado, at the base of the mountains, both on the east and west sides, August 24–27, 1900. Type: *Osterhout 2254.*

NEW WINDSOR, COLORADO.

Observations on the flora of central Chile

George Tracy Hastings

From the fall of 1900 until the spring of 1903 the author held the position of teacher of sciences in the *Instituto Inglés*, an English school in Santiago, Chile. Short holidays during the school year and the long vacation from Christmas to the first of March gave opportunities for collecting trips about the city and to the mountains to the east. In these trips the small lakes in the neighborhood of Santiago were visited and the mountains ascended to a height of twelve thousand feet. The following observations give the results of these trips.

Midway between the damp forests of the south and the deserts of the north, central Chile has a flora related to that of both, yet differing from each. From sea-level to the limit of shrubby growth on the mountains, thorny bushes are the characteristic plants. Most plants of the region show xerophytic modifications, for no rain falls from the first of September till the following June. By October the ground is fairly dry over the hills and higher land. By late November the green of winter and early spring is everywhere replaced by the brown of dry vegetation. The rapid rivers have cut deep valleys through the mountains and across the central plain, so that naturally mesophytic areas are found only in very narrow belts along the streams or in small mountain marshes. An extensive irrigating system has modified these natural conditions in the central plain to a considerable extent.

About Santiago the floral regions may be determined largely by elevation. Thus, there is the central plain with an elevation varying from one thousand to fifteen hundred feet; the hills from fifteen hundred feet to the limit of tree-growth at from five to eight thousand feet, the limit being higher in the interior than in the outer ranges of mountains; above this comes the high mountain flora extending to the region of perpetual snow.

In the first region the typical plant is the thorn-bush (*espino*), *Acacia Cavenia*, a shrub usually under ten feet in height, but sometimes becoming a small tree. It blossoms in early spring when the leaves are first appearing. During the middle of the day the leaflets close together, diminishing the transpiring surface. Frequently the *espino* covers large areas with the regularity of trees in an orchard; such areas are called *espinales*. At other times it is found in company with other thorny shrubs, but always maintaining its position as the dominant form. Throughout the region introduced herbs have the ascendency over the native: *Brassica Rapa*, *Raphanus sylvestris*, *Capsella Bursa-pastoris*, *Sisymbrium officinale*, species of *Erodium*, *Foeniculum vulgare*, *Medicago maculata*, *M. denticulata*, *Trifolium repens*, *Hordeum jubatum*, *H. murinum*, *Fumaria media*, *Centaurea melitensis*, *Cynara Carduncułus*, and others are very common along the roadsides, at the edges of cultivated fields, on all waste land, and even on the lower mountain-slopes. During the summer these introduced plants make up the greater part of the vegetation. In the early spring a larger number of native plants are found; such as various species of *Oxalis* (*O. lobata*, *O. articulata* and *O. micrantha*), *Dioscorea humifusa*, *Sagina apetala*, *Trichopetalum stellatum* and *Leucocoryne ixioides*. Besides the *Acacia*, a few other shrubs or small trees are found, as *Prosopis juliflora* (*P. Siliquastrum*), *Cestrum Parqui*, and *Talguenea costata*. Several species of *Cuscuta* and *Senecio* are also common.

This region is the only one brought under cultivation to any extent. A large number of the country roads have been formed into *alamedas* by planting Lombardy poplars along the small irrigating ditches that run at each side. Below these poplars *Rubus ulmifolius* frequently is planted and often grows to a height of over fifteen feet, spreading out on each side to form an impenetrable wall, replacing the mud walls that usually border the roads.

Several small areas of this central plain have a very distinct flora. There are a few small lakes, such as Aculeo and Batuco, which are swampy along the shores. Also along the irrigating ditches there are occasionally swampy places. Here are found such plants as *Eleocharis palustris*, *Cyperus vegetus*, *Typha angustifolia*, *Potamogeton pectinatus*, *P. Berteroanus*, *Zannichellia palustris*, *Myriophyllum verticillatum*, *Lemna minor*, *L. gibba*, *Azolla magellanica*, and *Cotula coronopifolia*.

The low hill and mountain region may easily be subdivided, although the divisions can not be sharply limited. There is considerable difference between northern and southern exposures at the same elevation, and the upper limit of many species is higher in the interior mountains than in the outer ranges.

The flora of the hills that rise abruptly from the central plain, as Cerro Blanco, San Cristobel, Renca and San Bernardo, is intermediate between that of the mountains and that of the plains. The *Acacia* is still one of the characteristic plants, but with it are many other shrubs, *Talguenea costata*, *Lithraea caustica*, *Colletia ferox*, *Muehlenbeckia chilensis*, *Colliguaya odorifera*, *Ephedra andina*, and the tall, columnar *Cereus Quisco*. The clumps of *Ephedra* seem to be as numerous on these low hills as on the higher slopes, where it extends close to the snow-line. On the hills it may be from four to six feet high, though it is so commonly cropped by cattle that it rarely attains such a height, while near the snow-line it is a matted shrub six or eight inches high. The herbaceous plants are typically Chilean, though a few naturalized species, such as *Fumaria media*, *Erodium cicutarium*, *Convolvulus arvensis*, *Marrubium vulgare*, *Centaurea melitensis* and *Cynara Cardunculus* are common. In the early spring *Trichopetalum stellatum*, with its delicately fringed white flowers, *Leucocoryne ixioides*, *Pasithea caerulea*, blue and yellow *Sisyrinchium*, species of *Oxalis*, and other, chiefly bulbous, plants are common. A little later several species of *Calceolaria*, especially *C. nudicaulis*, *C. purpurea*, and *C. adscendens*, species of *Loasa*, *Cajophora*, *Bowlesia*, *Tropaeolum*, *Moscharia* and *Triptilion* are the characteristic plants. By the last of November most of the spring flowers have matured fruits and are in a resting condition that lasts until the winter rains begin. Throughout the summer flowers are rare. The most attractive are composites, species of *Mutisia*, *Centaurea chilensis* and *Triptilion* sp. There are also a large number of less showy species, including species of *Baccharis*, *Senecio*, *Conyza*, and *Erigeron*.

The mountains proper have a greater number of shrubs. Near the streams are a few small trees, *Maytenus Boaria*, *Blepharocalyx*, *Myrtus*, *Cryptocarya Peumus*, *Quillaja saponaria*, and *Kageneckia oblonga*, all evergreen. On the drier slopes are thorny shrubs, *Talguenea*, *Colletia*, *Proustia pungens*, and others; poisonous shrubs, *Lithraea caustica*, *Colliguaya odorifera*, *C. integerrima* and *Cestrum Parqui;* and a few species of thornless broad-leafed trees, as the species of *Escallonia.* On the driest slopes are cacti, *Cereus Quisco* and smaller species, *Puya coarctata* and *Eryngium paniculatum.* The last two stand singly or in small groups and attract attention from a distance. *Puya* has a short prostrate trunk covered with the bases of dead leaves, at the end of which rises a crown of narrow, spine-toothed leaves often three feet long; from the center of this crown springs the flowering stalk, six to nine feet high, bearing a pyramid of blue-green flowers. These flowers contain an abundance of nectar and are much visited by bees and humming birds. *Eryngium paniculatum* resembles *Puya* in habit but is smaller. There are a few vines in this region. *Eccremocarpus scaber* is abundant in the moister situations, climbing over the shrubs and small trees, covering them with clusters of scarlet blossoms. In drier situations *Mutisia subulata* and *M. linearifolia* climb over anything to be found, and with their large heads of bright red are among the few bright flowers of summer. Of other plants the more common are species of *Calceolaria*, *Tropaeolum*, *Patagonium*, *Verbena*, and composites. Except along the small streams the vegetation is scattered, so that the gray, brown, or reddish soil gives the prevailing colors to the mountain sides. Near the streams the vegetation is denser. A shrub frequently found along the streams is *Aristotelia Maqui ;* the purplish berries are used by the country people to prepare a beverage or to color wine. Some of the *Myrtaceae* are also found along the streams, chiefly species of *Eugenia*, *Myrtus*, and *Blepharocalyx*, while the "peumo," *Cryptocarya Peumus*, the soap-tree, *Quillaja saponaria*, and *Kageneckia oblonga* become trees forty to fifty feet high. Where the ground is swampy *Drimys Winteri*, the only representative of the *Magnoliaceae* in Chile, is found.

At an altitude of about 5,000 ft. in the outer mountains and of 7,000 ft. in the interior, *Kageneckia angustifolia* is found, marking the upper limit of tree-growth. Above that comes the high mountain vegetation.

In this last region two zones are found. In the lower the plants are mainly in large low clumps or mats, the "Polster" formation of Reiche; in the upper the plants grow singly or in widely separated small clumps. The mats in the lower zone may be of one or several species. They are usually so dense that the lower portions are nearly solid with stems and dead leaves, with the green of new growth mantling the surface. Near the tree-line *Valenzuelia trinervis* is one of the principal plants in such formations. It grows to one or two feet in height and often solidly covers areas twenty to thirty feet in diameter. Similar, though smaller, mats are formed by the thorny umbellifer, *Mulinum spinosum*, by the composite, *Chuquiraga oppositifolia*, by *Ephedra andina*, and by other shrubby plants. With these there are other plants, especially bulbous ones, that develop in the spring while the ground is saturated with the water from melting snow. *Anemone chilensis*, *Diposis Bulbocastanum*, and species of *Liliaceae* and *Amaryllidaceae* are among these. *Luzula chilensis*, *Eleocharis striatula*, and a few grasses are found in marshy spots. Somewhat higher, *Laretia acaulis* forms dense mats, species of *Calceolaria* are found associated with various composites, *Aldunatea*, *Chaetanthera*, *Aplopappus*, and *Nassauvia*, species of *Argylia*, and others, all low perennials, in other mats.

The highest formation is of plants so scattered and small that from a short distance the ground seems absolutely barren. Of the plants found at these high levels many are tiny things hidden between stones and only noticed on close examination. *Aldunatea chilensis* may be taken as typical of these. The plant consists of a rosette of tiny leaves covered with a grayish felt. From the middle of a cluster of forty or fifty leaves grows the head, like a tiny daisy, the whole plant so small that it could be hidden under a quarter-dollar. Similar in general characters are *Viola Philippii* and other acaulescent violets, except that instead of a central flower a ring of tiny blue-black violets peep out around the rosette of leaves, the whole plant being rarely an inch and a half in diameter; the stout rootstock is closely marked with the scars of former leaves and blossoms. Other plants of similar habit are *Aldunatea gnaphalioides*, *Plantago* spp., and *Astragalus Germaini*, while *Nastanthus agglomeratus*, *A. spathulatus*, and *Phacelia circinata* are somewhat larger but of the same general habit.

An interesting group of plants was found in a little basin above Laguna Negra where the ground was saturated with water from the glacier a short distance above. *Luzula chilensis*, *Ranunculus chilensis* and *Calandrinia affinis* were growing in a thick carpet of moss. The delicate blossoms of the *Calendrinia* seemed like flakes of snow scattered from the neighboring drifts. Near the lake below grew *Tropaeolum polyphyllum*, *Schizanthus pinnatus* and species of *Hexaptera*. In the lake itself stood *Juncus pictus* and farther out a sparse growth of *Myriophyllum elatinoides ternatum*.

As has been mentioned, the southern slopes of the mountains have a flora somewhat different from the northern, as the south slopes are cooler and moister. As a result the vegetation on southern exposures is denser and more varied than that on the northern. At lower elevations the plants best fitted for desert conditions, such as *Cereus* and *Puya*, are found only on the northern slopes, while *Escallonia*, *Calceolaria*, *Verbena*, *Lippia* and others are found, chiefly on the southern.

Nearly everywhere *Cereus* serves as host for *Loranthus aphyllus*, the clusters of red flowers always springing from the axils of the thorns. These blossoms are usually considered to be the blossoms of the cactus by the country people. *Loranthus tetrandus*, abundant on the poplars of the long alamedas of the plain, is a serious pest on fruit trees and is found on nearly all the shrubs of the lower mountains. Other species of *Loranthus* are occasionally found and are confined to certain plants; thus *Loranthus cuneifolius* was found only on *Porlieria hygrometrica*.

Except for the small number of water and swamp plants, *Typha*, *Myriophyllum*, *Hydrocotyle*, *Montia*, *Potamogeton*, *Senecio fistulosus*, *Cotula*, *Eleocharis*, *Juncus* and *Drimys Winteri*, nearly all the plants show xerophytic adaptations; and the waxy coating of the leaves of *Drimys* may be considered as a xerophytic modification. Many of the plants complete their growth during one or two months of early spring, while the ground is moist, and then spend the summer in a resting condition, storing in a bulb or other underground stem the food that enables them to make a vigorous start the following spring. *Diposis Bulbocastanum*, *Cardamine alsophila*, *Oxalis articulata*, *Tropaeolum tricolor*, *T. brachyceras*, *Pasithea coerulea*, and many others belong to this group.

A smaller number of plants develop their leaves early, and flower in the summer after the leaves have disappeared. Among these are several species of *Alstroemeria.*

Many reduce the leaf-surface; some, as the cacti and *Ephedra*, have no functional leaves at any season; others have a well-developed leaf-system during the spring, but lose their leaves in summer. *Colletia ferox*, leafy during early spring, is at other seasons a mass of naked, thorny branches, the green epidermis taking the place of the leaves. *Talguenea costata, Schinus dependens, Proustia pungens*, and many others retain but a very few leaves during the summer. Others, as *Baccharis sagittalis, Mulinum spinosum, Acacia Cavenia*, species of *Calendrinia, Mutisia* and *Nassauvia*, have but a few small leaves throughout the growing period. Many, as *Aldunatea*, species of *Viola, Chuquiraga*, and *Nassauvia*, have small leaves closely crowded in rosettes or appressed closely to the stems. The crowding of the leaves in the mat formations of the mountains results in a reduced transpiring surface as well as protection from wind and snow.

Most of the trees are evergreen and have a waxy covering on the leaves. *Quillaja saponaria, Boldoa fragrans, Lithraea caustica, Kageneckia oblonga, Colliguaya* spp., *Escallonia arguta* and others have one or both sides of the leaves covered with a wax or varnish. A somewhat smaller number of plants have a resinous coating, among them several species of *Baccharis, Madia sativa, Cephalophora aromatica* and *Fabiana imbricata.* The last of these also has the leaves very small and closely appressed to the stems. Others, especially mountain plants, have the leaves densely covered with hairs; such are species of *Gnaphalium, Astragalus, Aldunatea* and *Patagonium.* During the middle of the day the leaflets of *Acacia Cavenia, Porlieria hygrometrica, Patagonium arboreum*, and a few other shrubs fold together, reducing the leaf-surface and placing the leaves edgewise to the sun's rays.

Nearly all the plants of the region have an extensive and usually deep root-system. The cacti, *Puya*, and certain orchids, as *Chloraea*, have fleshy stems that serve as water-reservoirs. *Alstroemeria, Oxalis*, and many others store water in the underground stems. Specimens of *Pasithea coerulea* had so much water in the stems and tubers and were so well protected by a waxy covering that after being put in press fruits were matured from flowers that had just opened when they were put between the driers.

While several of the plants collected are not described in Gay's Historia de Chile, nearly all were found in the volumes so far pub-

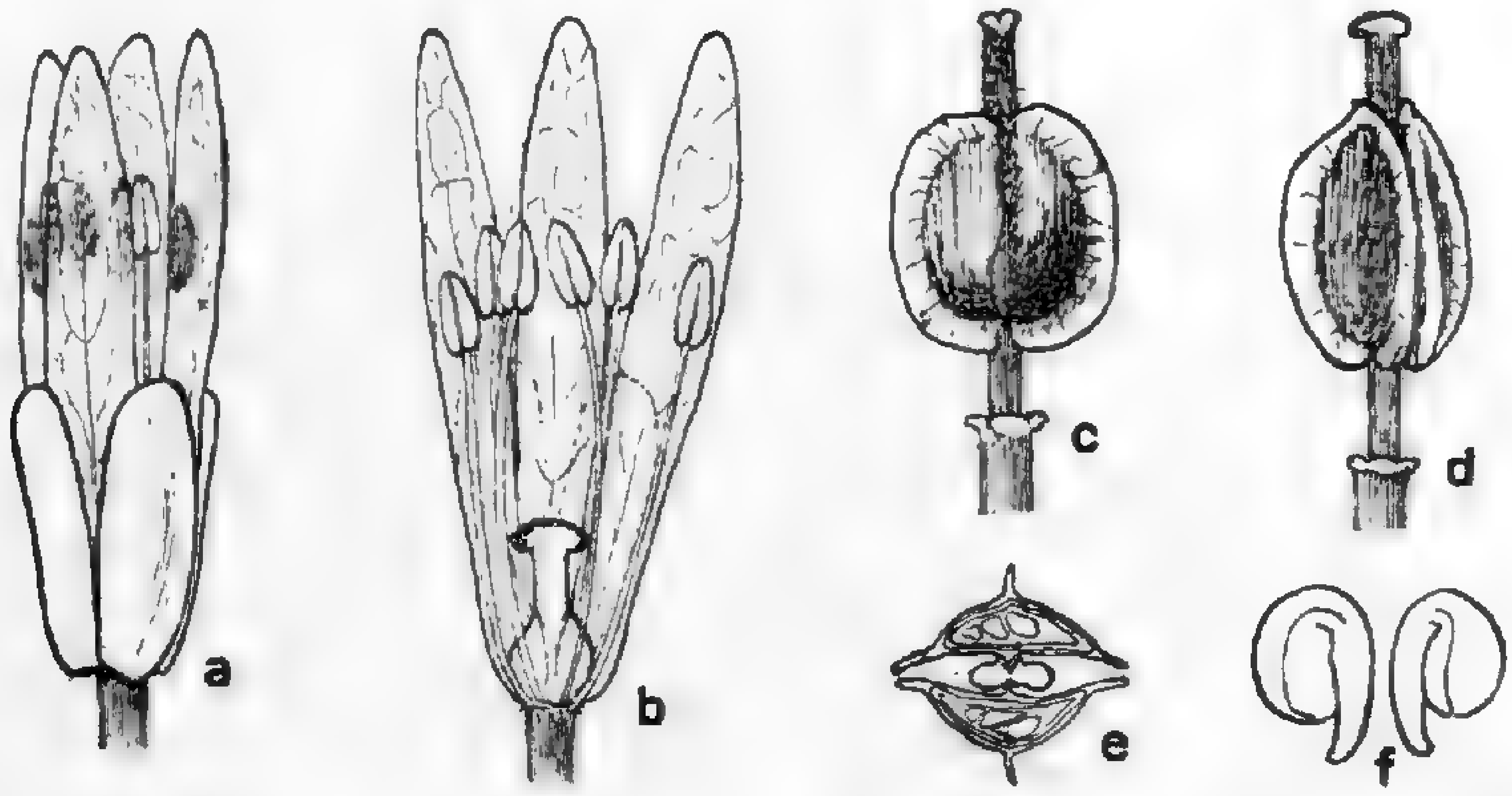

FIGURE 1. *Hexaptera purpurea* sp. nov. *a*, flower; *b*, flower, with one petal and two sepals removed; *c*, fruit, dorsal view; *d*, fruit, lateral view; *e*, fruit, transverse section; *f*, embryos.

lished of Reiche's Flora de Chile, that belonged to the orders therein described. Therefore, no attempt has been made to describe new species, with the exception of a *Hexaptera* (a small genus of the *Cruciferae* occurring only in Chile) found in the mountains near Laguna Negra.

Hexaptera purpurea sp. nov.

Perennial; stems 1–5, simple, smooth, green or purplish, 25–35 cm. high: leaves crowded at base of stem, narrowly spatulate, 5–7 cm. long, 2–5 mm. broad near the apex, tapering to the base, entire or with 1 or 2 sharp teeth near the apex, smooth, slightly fleshy; upper leaves few, smaller, 2–3 cm. long, 1–2 mm. broad: raceme terminal, simple or with 1–5 branches: flowers crowded: branches and stems elongating slightly after flowering so that the fruits are nearly separated except at the ends of the branches: peduncles 1–2 mm. long: sepals oblong, 4 mm. long, violet or black, erect: petals twice as long as the sepals, yellowish, violet on outer sides near tips: stamens free: fruit purple, the narrow wings white or slightly tinted.

Among rocks, near Laguna Negra, 3,500 m., province of Santiago, *Hastings 480*, February 6, 1902.

Distinguished from *H. linearis* Barn. by the numerous leaves at the base of the stems, the leaves tapering to petioles, the branching, many-flowered racemes, and the violet-tinted petals.

Acknowledgment is due Prof. W. W. Rowlee for advice and assistance in determining the species collected, and to Cornell University for the use of a large amount of literature on the flora of Chile.

The species were named according to Reiche's "Flora de Chile," as far as published; otherwise the names are those given in Philippi's "Catalogus plantarum vascularium chilensium."

WENONAH, NEW JERSEY.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Abrams, L. R. Studies on the flora of Southern California. Bull. Torrey Club **32**: 537–541. 21 O 1905.

Including descriptions of new species in *Hookera*, *Abronia* (2), *Delphinium*, *Acrolasia*, *Sphaerostigma*, *Godetia*, *Gilia*, and *Diplacus*.

Adams, C. C. The post-glacial dispersal of the North American biota. Rep. Eighth Internat. Geogr. Congr. 623–637. *map*. 1905.

Anderson, R. J. The flora of Connaught as evidence of the former connection with an Atlantic continent. Rep. Eighth Internat. Geogr. Congr. 613–615. 1905.

Arechavaleta, J. Flora Uruguaya **2**: 161–377. *pl. 1–35 + f. 1–5*. 1905.

Anal. Mus. Nac. Montevideo, vol. 5.

Bain, S. M. & Essary, S. H. A preliminary note on clover diseases in Tennessee. Science II. **22**: 503. 20 O 1905.

Baker, E. G. Notes on *Cardamine*. Jour. Bot. **43**: 254–256. S 1905.

Baker, J. G. A revised classification of roses, 1905. Jour. Linn. Soc. Bot. **37**: 70–79. 1 Jl 1905.

Beauverd, G. Plantae Damazianae brasilienses déterminées par différents botanistes. Bull. Herb. Boissier II. **5**: 284–287. 28 F 1905; 404–407. 31 Mr 1905.

Beauverd, G. Une nouvelle Burmanniacée du Brésil. Bull. Herb. Boissier II. **5**: 948. 30 S 1905.
Burmannia Damazii sp. nov.

Berry, E. W. An old swamp-bottom. Torreya **5**: 179–182. *f. 1.* 27 O 1905.

Blodgett, F. H. A nature study of Maryland plants. Md. Agr. Coll. Bull. **2**: 1–22. 1905. [Illust.]

Britten, J. Note on the history of *Cliftonia*. Jour. Bot. **43**: 282–284. O 1905.

Britton, E. G. The botanical congress at Vienna. Bryologist **8**: 80, 81. 1 S 1905.

Britton, N. L. Bermuda in September. Jour. N. Y. Bot. Gard. **6**: 153–158. *pl. 29, 30.* O 1905.

Brotherus, V. F. *Pleurorthrotrichum*, eine neue Laubmoosgattung aus Chile. Öfv. Finska Vet.-Soc. Förh. **47**[15]: 1–4. *pl.* 1905.
P. chilense gen. et sp. nov.

Brown, F. B. H. A botanical survey of the Huron River valley. III. Bot. Gaz. **40**: 264–284. *f. 1–5 + map.* 18 O 1905.

Campbell, D. H. The structure and development of mosses and ferns (*Archegoniatae*). [Ed. 2.] i–vii. 1–657. *f. 1–322.* New York, S 1905.

Campbell, R. Some conspicuous British Columbia summer plants. Can. Rec. Sci. **9**: 176–189. 20 Ap 1905.

Cannon, W. A. A new method of measuring the transpiration of plants in place. Bull. Torrey Club **32**: 515–529. *f. 1–5.* 21 O 1905.

Chamberlain, E. B. Notes upon Maryland bryophytes and on two mosses from Virginia. Bryologist **8**: 77, 78. 1 S 1905.

Christ, H. Primitiae florae costaricensis. *Filices* et *Lycopodiaceae* III. Bull. Herb. Boissier II. **5**: 248–260. 28 F 1905.
Includes descriptions of 11 new species in 8 genera.

Clements, F. E. Research methods in ecology. i–xvii. 1–334. *f. 1–85.* Lincoln, Neb., 1905.

Collins, F. S. Phycological notes of the late Isaac Holden,—I. Rhodora **7**: 168–172. 19 S 1905.

Copp, G. G. The desert's natural reservoirs. Shields' Mag. **1**: 387, 388. N 1905. [Illust.]

Coulter, S. *Cuscuta americana* L. Proc. Ind. Acad. Sci. **1904**: 207–211. 1905.

Coulter, S. The poisonous plants of Indiana. Proc. Ind. Acad. Sci. **1904**: 51–63. 1905.

Cowles, H. C. Importance of the physiographic standpoint in plant geography. (Abstract.) Rep. Eighth Internat. Geogr. Congr. 600. 1905.

Cowles, H. C. A remarkable colony of northern plants along the Apalachicola River, Florida, and its significance. (Abstract.) Rep. Eighth Internat. Geogr. Congr. 599. 1905.

Curtis, C. C. The pines of the northwest. Shields' Mag. **1**: 383–385. N 1905. [Illust.]

Cushman, J. A. The desmid flora of Nantucket. Bull. Torrey Club **32**: 549–553. 27 O 1905.

Dams, E. *Cereus Wittii.* Monats. Kakteenk. **15**: 22. 15 F 1905. [Illust.]

Dams, E. *Mamillaria radians* P. DC. var. *impexicoma* S.-D. Monats. Kakteenk. **15**: 6. 15 Ja 1905. [Illust.]

Dandeno, J. B. The parachute effect of thistle-down. Science II. **22**: 568–572. *f. 1–4.* 3 N 1905.

Davis, W. T. A new station for the hybrid oak, *Quercus Brittoni* Davis. Proc. Nat. Sci. Assoc. Staten Island **9**: 38. F 1905.

Deam, C. C. Additions to the Indiana flora. Proc. Ind. Acad. Sci. **1904**: 219–221. 1905.

DeCandolle, C. *Meliaceae* costaricenses. Bull. Herb. Boissier II. **5**: 417–427. 29 Ap 1905.

Includes new species in *Guarea* (5), *Trichilia* (8), and *Cedrela.*

DeCandolle, C. Species novae brasilienses a L. Damazio lectae. Bull. Herb. Boissier II. **5**: 230, 231. *f. 1, 2.* 28 F 1905.

Lundia Damazii and *Oxalis Damazii* spp. nov.

DeCandolle, C. Sur le calice du *Lundia Damazii* C. DC. Bull. Herb. Boissier II. **5**: 228–230. *f. 1–8.* 28 F 1905.

Dismier, G. Note sur le *Webera annotina* auct. Rev. Bryol. **32**: 87–92. 1905. [Illust.]

Douglass, B. W. Additions to the flora of Marion County, with notes on plants heretofore unreported from the state of Indiana. Proc. Ind. Acad. Sci. **1904**: 223, 224. 1905.

Dowell, P. Additions to the flora of Staten Island. Proc. Nat. Sci. Assoc. Staten Island **9**: 41, 42. Mr 1905.

Drude, O. Die Methode der pflanzengeographischen Kartographie, erläutert an der Flora von Sachsen. Rep. Eighth Internat. Geogr. Congr. 608–612. 1905.

Earle, F. S. Nomenclature at the international botanical congress at Vienna. Science II. **22**: 468, 469. 13 O 1905.

Eckerson, S. The physiological constants of plants commonly used in American botanical laboratories. I. Bot. Gaz. **40**: 302–305. 18 O 1905.

Elrod, M. N. Pollination of *Campanula americana* and other plants. Proc. Ind. Acad. Sci. **1904**: 213–217. *f. a–d.* 1905.

Engler, A. Beiträge zur Kenntnis der *Araceae*. X. Bot. Jahrb. **37**: 110–143. 19 S 1905.

With descriptions of 79 new American species in 15 genera; including *Caladiopsis* gen. nov.

Engler, A. *Ulearum* Engl. nov. gen. Bot. Jahrb. **37**: 95, 96. 19 S 1905. [Illust.]

Fedde, F. Die geographische Verbreitung der *Papaveraceae*. Bot. Jahrb. Beibl. **81**: 28–43. 22 Au 1905.

Fernald, M. L. *Symphoricarpos racemosus* and its varieties in eastern America. Rhodora **7**: 164–167. 19 S 1905.

Fink, B. What to note in the macroscopic study of lichens. Bryologist **8**: 73–76. 15 Jl 1905;—II. Bryologist **8**: 86–90. 1 S 1905.

Freeman, E. M. Minnesota plant diseases. i–xxiii. 1–432. *f. 1–211.* Saint Paul, Minn., 31 Jl 1905.

Rep. Geol. & Nat. Hist. Surv. Bot. Series V.

Gibson, W. H. & Jelliffe, H. L. Our native orchids: a series of drawings from nature of all the species found in the northeastern United States. With descriptive text. i–xxxv. 1–158. New York, Je 1905. [Illust.]

Gilbert, B. D. The advantage of frequent visits to moss localities. Bryologist **8**: 93, 94. 1 S 1905.

Gürke, M. *Echinocactus Arechavaletai* K. Schum. Monats. Kakteenk. **15**: 106–110. 15 Jl 1905. [Illust.]

Harper, R. M. "Hammock," "Hommock," or "Hummock"? Science II. **22**: 400–402. 29 S 1905.

Harper, R. M. *Mesadenia lanceolata* and its allies. Torreya **5**: 182–185. 27 O 1905.

Harris, J. A. The fruit of *Opuntia*. Bull. Torrey Club **32**: 531–536. 21 O 1905.

Harshberger, J. W. Methods of determining the age of the different floristic elements of eastern North America. Rep. Eighth Internat. Geogr. Congr. 601–607. 1905.

Harwood, W. S. New creations in plant life: an authoritative account of the life and work of Luther Burbank. i–xiv. 1–368. New York, 1905. [Illust.]

Hassel, J. M. von. La industria gomera en el Peru. 1–29. Lima, 1905. [Illust.]

Hollick, A. Additional notes on the occurrence of amber at Kreischerville. Proc. Nat. Sci. Assoc. Staten Island **9**: 35, 36. Ja 1905.

Holm, T. Studies in the *Cyperaceae*. XXIV. New or little known *Carices* from Northwest America. Am. Jour. Sci. IV. **20**: 301–307. *f. 1–18*. O 1905.

Includes descriptions of 7 new species.

Holzinger, J. M. *Bryum Fosteri* n. sp. Bryologist **8**: 80. 1 S 1905.

A new name for *B. Baileyi* Holz., not *B. Baileyi* Broth.

Howe, J. L. A tree's limb without bark. Science II. **22**: 527, 528. 27 O 1905.

Howe, R. H. *Lotus tenuis* as a waif in Rhode Island. Rhodora **7**: 167, 168. 19 S 1905.

Hua, H. *Metastelma longisepalum* Hua, Asclepiadacée nouvelle du Brésil. Particularités morphologiques inaperçues du groupe auquel elle appartient. Bull. Herb. Boissier II. **5**: 97–99. 31 Ja 1905.

Kinney, A. S. Outline of a course in plant culture. Plant World **8**: 234–258. [O] 1905.

Kraemer, H. Further observations on the structure of the starch grain. Bot. Gaz. **40**: 305–310. 18 O 1905.

Kraemer, H. Plant morphology and taxonomy. Am. Jour. Pharm. **77**: 401–416. S 1905.

Kränzlin, F. *Calceolariae* generis species novae (septem) centrali- et austro-americanae. Repert. Nov. Sp. **1**: 82–85. 20 S 1905; 97–107. 30 S 1905.

Descriptions of 29 new species, one from Mexico, the remainder South American.

Kränzlin, F. *Orchidaceae* novae austro-americanae plerumque peruanae. Repert. Nov. Sp. **1**: 85–92. 20 S 1905.

Descriptions of 13 new species in 8 genera.

Lemmerman, E. Das Phytoplankton des Meeres. III. Beitrag. Beih. Bot. Centralb. **19**^{2}: 1–74. 1905.

Lindau, G. *Acanthaceae* americanae IV. Bull. Herb. Boissier II. **5**: 367–374. 31 Mr 1905.

Descriptions of 10 new species in 7 genera, including *Diateinacanthus* gen. nov.

Lloyd, F. E. The artificial induction of leaf-formation in the ocotillo. Torreya **5**: 175–179. *f. 1, 2.* 27 O 1905.

Lloyd, F. E. The barley-corn. I. Some points of structure. Plant World **8**: 223–232. *f. 40–48.* [O] 1905.

Lyon, F. The spore-coats of *Selaginella.* Bot. Gaz. **40**: 285–295. *pl. 11, 12.* 18 O 1905.

McCallum, W. B. Regeneration in plants. II. Bot. Gaz. **40**: 241–263. *f. 1–9.* 18 O 1905.

MacDougal, D. T. In the delta of the Rio Colorado. Shields' Mag. **1**: 369–377. N 1905. [Illust.]

Macoun, W. T. Why our field and roadside weeds are introduced species. Ottawa Nat. **19**: 124, 125. 11 S 1905.

Mann, A. Diatoms, the jewels of the plant-world. Smithson. Misc. Coll. **48**: 50–58. *pl. 22–25 + f. 8–16.* 23 My 1905.

Maxon, W. R. A new species of fern of genus *Polypodium* from Jamaica. Smithson. Misc. Coll. **47**: 410, 411. *pl. 57.* 5 Ap. 1905.

P. nesioticum sp. nov.

Mez, C. Additamenta monographica 1904. Bull. Herb. Boissier II. **5**: 100–116. 31 Ja 1905; 232–247. 28 F 1905; 527–538. 31 My 1905.

New American species in *Tillandsia* (13), *Guzmania* (10), *Glomeropitcairnia* gen. nov., *Silvia*, *Aniba*, *Endlicheria* (2), *Ocotea* (11), *Nectandra* (2), *Grammadenia*, *Cybianthus*, *Geissanthus*, *Conomorpha*, *Comomyrsine*, *Rapanea* (2), and *Clavija.*

Pease, A. S. Notes on the accentuation of certain generic names. Rhodora **7**: 157–161. 19 S 1905.

Peckolt, T. Volksbenennungen der brasilianische Pflanzen und Produkte in brasilianischer (portugiesischer) und von der Tupisprache adoptiren Namen. Pharm. Rev. **23**: 76–80. Mr 1905; 236–238. Au 1905.

Penhallow D. P. The mycelium of dry rot. Can. Rec. Sci. **9**: 318. 15 My 1905.

Penhallow, D. P. Observations upon some noteworthy leaf-variations, and their bearing upon palaeontological evidence. Can. Rec. Sci. **9**: 279–305. *f. 1–11.* 15 My 1905.

Perrédès, P. E. F. London botanic gardens. Am. Jour. Pharm. **77**: 451–459. *pl. 1–7.* O 1905; 523–530. *pl. 8.* N 1905.

Peterson, M. G. How to know wild fruits: a guide to plants when not in flower by means of fruit and leaf. i–xliii. 1–340. New York, My 1905. [Illust.]

Piper, C. V. *Agropyron tenerum* and its allies. Bull. Torrey Club **32**: 543–547. 21 O 1905.

Radlkofer, L. *Guareae* species duae novae costaricenses. Bull. Herb. Boissier II. **5**: 191–193. 31 Ja 1905.
G. rhopalocarpa and *G. bullata* spp. nov.

Radlkofer, L. *Sapindaceae* costaricenses determinatae novaeque descriptae. Bull. Herb. Boissier II. **5**: 319–328. 31 Mr 1905.
Includes new species in *Paullinia* (4), *Thouinia*, and *Cupania*.

Radlkofer, L. *Sapindaceae* novae e generibus *Serjania* et *Paullinia* (collectionum Ule, Weberbauer, Smith et Williams). Bot. Jahrb. **37**: 144–155. 19 S 1905.
Descriptions of new species in *Serjania* (8) and *Paullinia* (7).

Ramaley, F. The botanical garden at Buitenzorg, Java. Pop. Sci. Mo. **67**: 579–589. N 1905. [Illust.]

Rolfe, R. A. *Mormodes buccinator* var. *aurantiacum*. Curt. Bot. Mag. IV. **1**: *pl. 8041*. 1 O 1905.
Native of tropical America.

Rose, J. N. Five new species of Mexican plants. Proc. U. S. Nat. Mus. **29**: 437–439. 1905.
New species in *Polianthus*, *Nolina*, *Parnassia*, *Heuchera*, and *Dahlia*.

Rose, J. N. Two new umbelliferous plants from the coastal plain of Georgia. Proc. U. S. Nat. Mus. **29**: 441, 442. *pl. 3*. 1905.
Harperia nodosa gen. et sp. nov., and *Zizia arenicola* sp. nov.

Rose, J. N. & House, H. D. Descriptions of three Mexican violets. Proc. U. S. Nat. Mus. **29**: 443, 444. *pl. 4*. 1905.
Including a description of *Viola Painteri* sp. nov.

Rydberg, P. A. Explorations in Utah. Jour. N. Y. Bot. Gard. **6**: 158–165. O 1905.

Sargent, C. S. Recently recognized species of *Crataegus* in eastern Canada and New England — VI. Rhodora **7**: 162–164. 19 S 1905.
Two species are described as new.

Sargent, F. L. Lichenology for beginners — III. Bryologist **8**: 81–86. *f. 7–17*. 1 S 1905.

Schneider, A. Contributions to the biology of rhizobia. V. The isolation and cultivation of rhizobia in artificial media. Bot. Gaz. **40**: 296–301. 18 O 1905.

Schneider, C. K. Uebersicht über die spontanen Arten und Formen der Gattung *Spiraea* (*Euspiraea*). Bull. Herb. Boissier II. **5**: 335–350. 31 Mr 1905.

Recognizes 57 species, of which 8 or 9 are (North) American.

Simmons, H. G. Remarks about the relations of the floras of the northern Atlantic, the Polar Sea, and the northern Pacific. Beih. Bot. Centralb. **19**[2]: 149–194. 1905.

Smith, C. P. Notes upon some little known members of the Indiana flora. (Paper number two.) Proc. Ind. Acad. Sci. **1904**: 301–303. 1905.

Sodiro, L. Plantae ecuadorenses. IV. Bot. Jahrb. **36**: 377–388. 22 Au 1905.

Including new species in *Monnina* (4), *Maytenus* (2), *Paullinia*, *Dunalia*, *Acnistus*, *Iochroma* (4), and *Poecilochroma*.

Sprague, T. A. *Manettiarum* pugillus. Bull. Herb. Boissier II. **5**: 264–267. 28 F 1905.

Includes descriptions of 4 new species.

Sprague, T. A. *Manettiarum* pugillus alter. Bull. Herb. Boissier II. **5**: 832–836. 31 Au 1905.

Includes descriptions of 5 new species.

Sprague, T. A. Plantarum novarum vel minus cognitarum diagnoses. Bull. Herb. Boissier II. **5**: 700–704. 30 Je 1905.

Includes new American species in *Anona* (2), *Apeiba*, and *Mollia*.

Stevens, F. L. The science of plant pathology. Jour. Elisha Mitchell Soc. **21**: 61–75. 20 S 1905.

Reprinted from Pop. Sci. Mo. **67**: 399–408. S 1905.

Tidestrom, I. Notes on the gray polypody. Torreya **5**: 171–175. *f. 1.* 27 O 1905.

Marginaria polypodioides (L.) Tidestrom, nom. nov.

True, R. H. Notes on the physiology of the sporophyte of *Funaria* and of *Mnium*. Beih. Bot. Centralb. **19**[1]: 34–44. 1905.

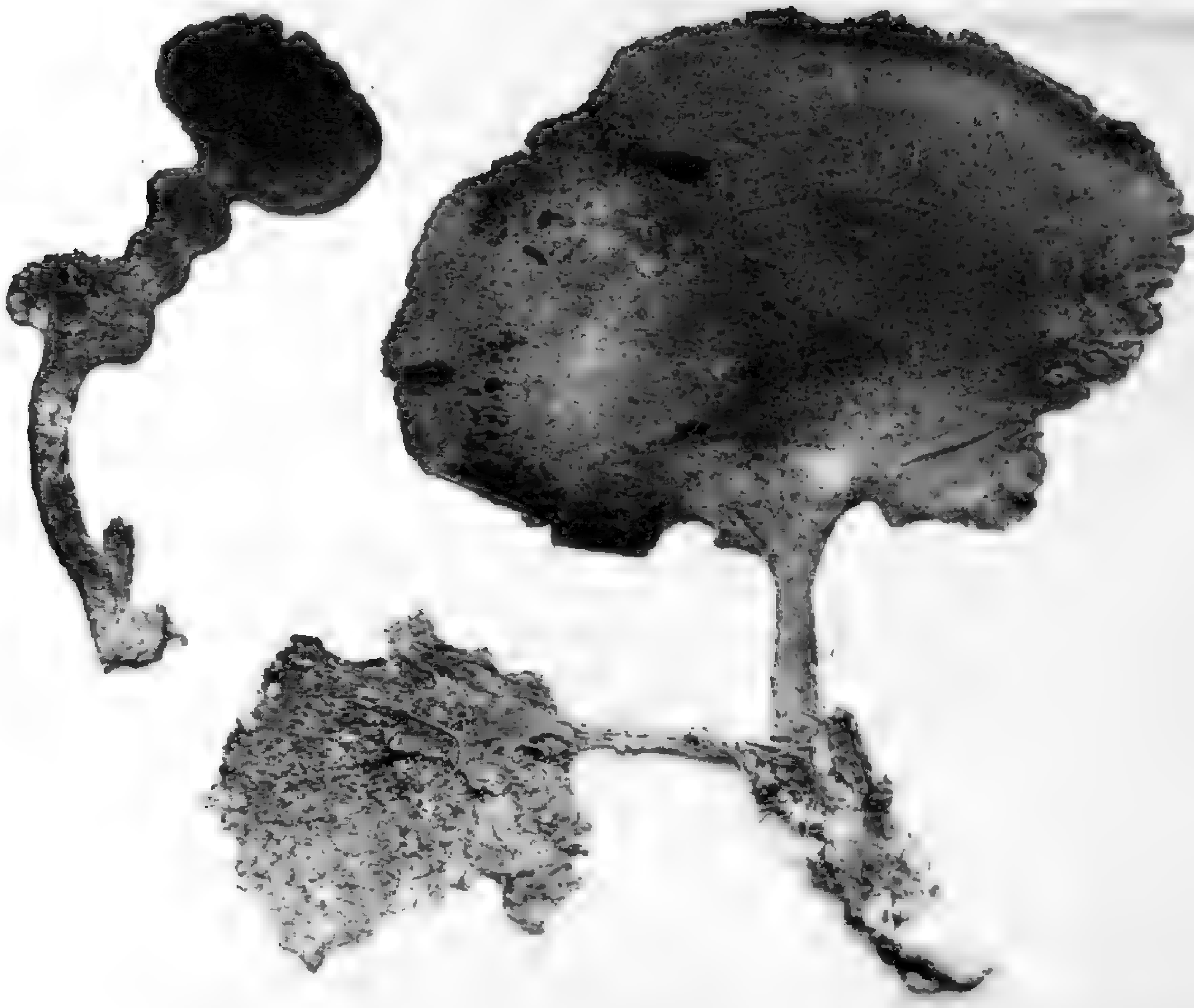
Ule, E. Biologische Eigentümlichkeiten der Früchte in der Hylaea. Bot. Jahrb. Beibl. **81**: 91–98. 22 Au 1905. [Illust.]

VanHorne, M. Some mushrooms found in Canada. Can. Rec. Sci. **9**: 157–175. 20 Ap 1905.

Warburg, O. *Myristicaceae* costaricenses. Repert. Nov. Sp. **1**: 71, 72. 20 S 1905.

Compsoneura costaricensis and *Virola Koschnyi* spp. nov.

Weberbauer, A. Anatomische und biologische Studien über die Vegetation der Hochanden Perus. Bot. Jahrb. **37**: 60–94. 19 S 1905.



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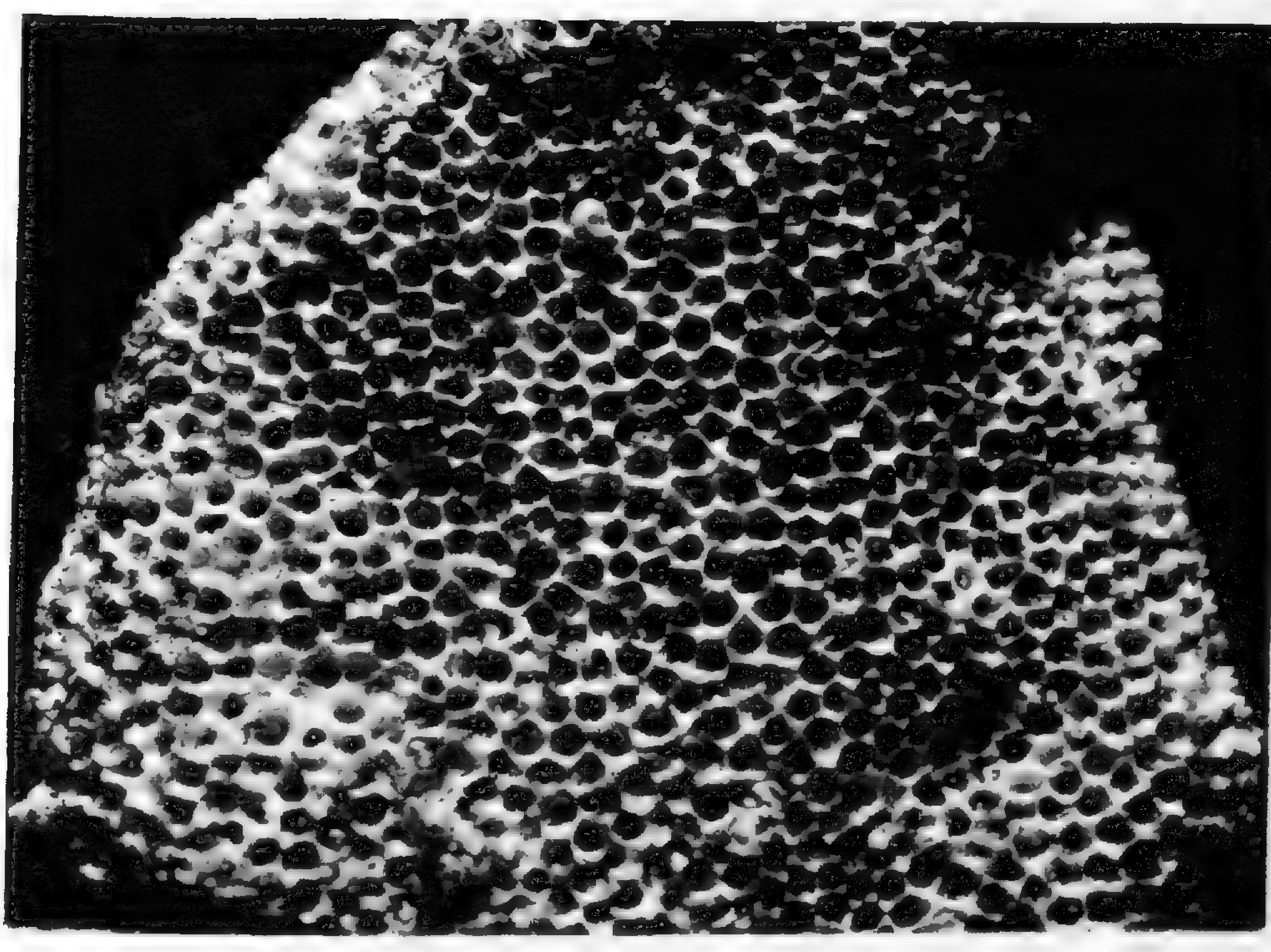

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1. AVRAINVILLEA LEVIS M. A. Howe

2. HALIMEDA FAVULOSA M. A. Howe

HALIMEDA FAVULOSA M. A. Howe

CLADOCEPHALUS SCOPARIUS M. A. Howe

1-6. HALIMEDA FAVULOSA M. A. Howe

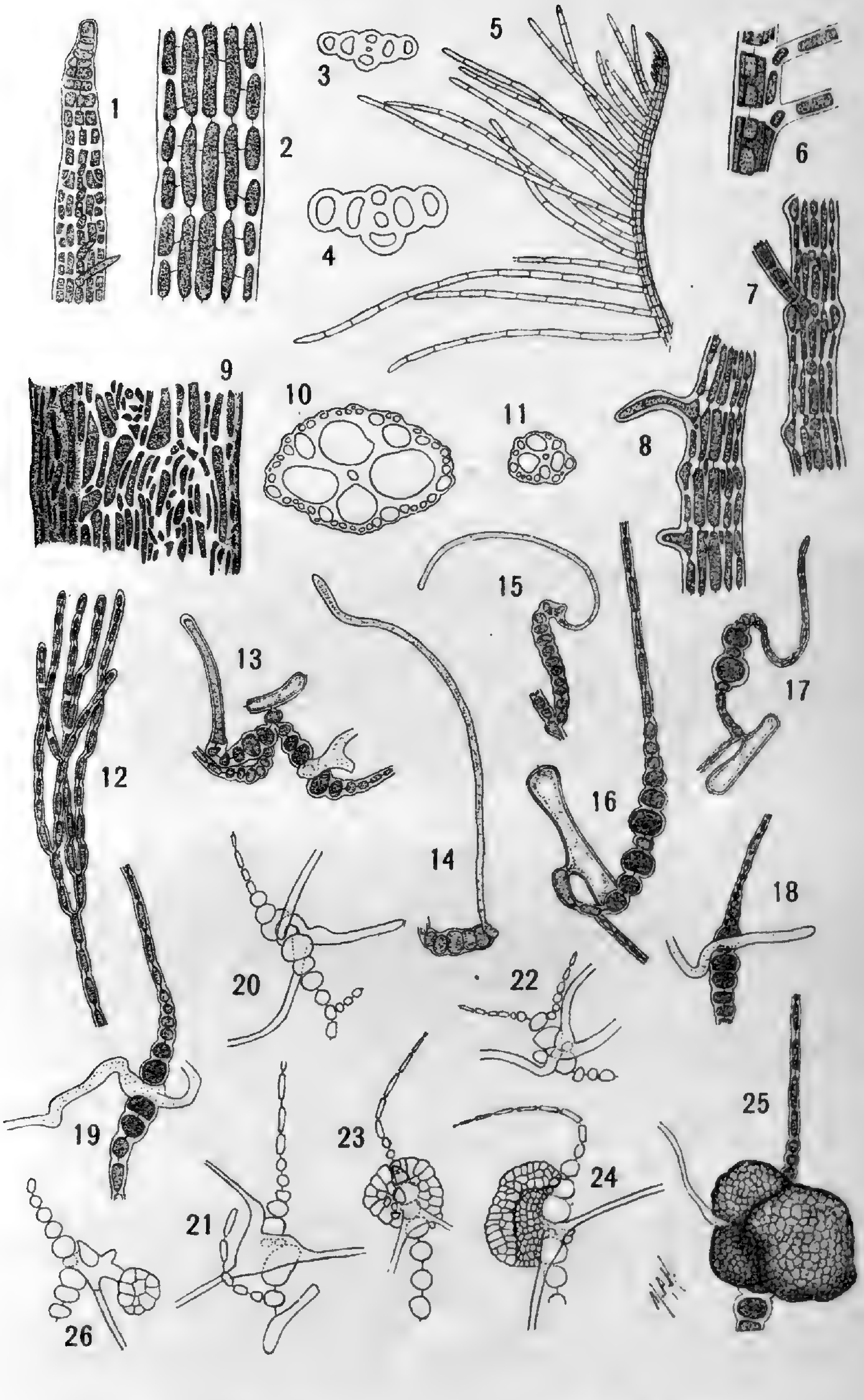
7. HALIMEDA TRIDENS (Ell. & Soland.) Lamour.

8-10. AVRAINVILLEA LEVIS M. A. Howe

11-20. CLADOCEPHALUS SCOPARIUS M. A. Howe

SARCOMENIA FILAMENTOSA M. A. Howe

DUDRESNAYA CRASSA M. A. Howe.



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Vol. 3, No. 2; price, $2.00:

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Rusby, H. H. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Apr 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, L. M. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, J. K. & Vail, A. M. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 92–201, *plates 75–82.* 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, H. H. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, A. S. *Arachis hypogaea* L. Pages 275–296, *plates 83–85.* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, P. A. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

VOL. 32 DECEMBER, 1905 NO. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

CONTENTS

PUBLISHED FOR THE CLUB

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THE TORREY BOTANICAL CLUB

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Vol. 32 No. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

DECEMBER, 1905

The Polyporaceae of North America — XIII. The described species of Bjerkandera, Trametes, and Coriolus

WILLIAM ALPHONSO MURRILL

In article XII of this series the above genera were listed and described in their proper order, but the species were omitted for lack of space. The present paper deals with the published species only of these three genera.

BJERKANDERA Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879

Merisma Gill. Champ. Fr. **1**: 688. 1878. Not *Merisma* Persoon.

Myriadoporus Peck, Bull. Torrey Club **11**: 27. 1884.

This genus was based on *Bjerkandera adusta* (Fr.) and six other species, and described as follows:

"Receptaculum pileatum, sessile, carnoso-lentum, molle, elasticum, anodermeum. Pileus azonus. Hymenium heterogeneum. Pori colorati, integri."

Merisma of Gillet was based on *Merisma imberbe* (Bull.) and twelve other species. The name had been previously used by different authors for groups of fungi in which the sporophore was branched. Persoon used it for a group of the *Clavariaceae.*

Myriadoporus of Peck was founded upon *Myriadoporus adustus* Peck, which is only an abnormal form of *Bjerkandera adusta* (Willd.) Karst., and hence a synonym.

Synopsis of the North American species

1. Hymenium smoke-colored when very young, becoming black with age. 1. *B. adusta.*

Hymenium pallid when very young, becoming more or less smoke-colored with age. 2.

[The BULLETIN for November (**32**: 563–632, *pl. 23–29*) was issued 6 D 1905.]

2. Tubes round, equal and rather thick-walled at maturity, becoming lacerate only with age; plant not fragrant. 2. *B. fumosa.*
Tubes angular, unequal and thin-walled at maturity; plant fragrant. 3. *B. fragrans.*

1. BJERKANDERA ADUSTA (Willd.) Karst.

Boletus adustus Willd. Fl. Berol. 392. 1787.
Boletus fuscoporus Plan. Pl. Erf. 26. 1788.
Boletus suberosus Batsch, Elench. Fung. *pl. 226.* 1789.
Boletus pelleporus Bull. Herb. Fr. **11**: *pl. 501. f. 2.* 1790.
Boletus carpineus Sowerby, Eng. Fung. *pl. 231.* 1799.
Boletus adustus crispus Pers. Obs. Myc. **2**: 8. 1799.
Polyporus crispus Fr. Obs. Myc. **1**: 127. 1815.
Boletus isabellinus Schw. Syn. Fung. Car. 70. 1818.
Polyporus adustus Fr. Syst. Myc. **1**: 363. 1821.
Polyporus subcinereus Berk. Ann. Mag. Nat. Hist. **3**: 391. 1839.
Polyporus Halesiae B. & C. Ann. Mag. Nat. Hist. II. **12**: 434. 1853. — Grevillea **1**: 52. 1872.
Bjerkandera adusta Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879.
Myriadoporus adustus Peck, Bull. Torrey Club **11**: 27. 1884.
Polyporus Burtii Peck, Bull. Torrey Club **24**: 146. 1897.

The history of this fungus has been that of most of our abundant, widespread and variable species: it has been named and renamed again and again in various countries by mycologists not in touch with each other and not conversant with the work already done, until, with types gone and data lost, it seems wellnigh impossible to follow the various specific and varietal names with exactness. The above list, however, while not complete, represents fairly well the best known synonyms since Willdenow first described it in 1787.

Four or more new names have been given the plant in this country from the days of Schweinitz to the present time. Berkeley's name, *P. subcinereus*, assigned to plants collected at Carlton House by Richardson, was corrected by Montagne and the correction accepted by Berkeley. *P. Halesiae*, described from plants collected by Ravenel on *Halesia tetraptera* in Georgia, is acknowledged by the authors to be allied to *P. crispus*, but claimed to be distinct. *P. crispus* itself was without sufficient reason raised to specific rank from the varietal distinction accorded it by Persoon. In describing *P. Burtii* from plants collected on birch in Vermont, Peck says "This fungus is closely allied to *Polyporus adustus*, of which it might easily be considered a mere variety."

The pallid pileus and small-pored, dark hymenium, which looks as though it had been too near to a forest fire, are well known to most collectors. In its resupinate forms it is not easily distinguished from *P. dichrous* and from *Gloeoporus conchoides*. The spores are smooth, hyaline, ellipsoid-allantoid, $3\text{–}5 \times 1.5\text{–}2.5\ \mu$. Specimens are abundant on all kinds of dead deciduous wood and only representative ones will be listed here in order to show the wide range of the species:

Germany, *Magnus*; Hungary, *Dietz*; Sweden, *Murrill*; England, *Murrill*; Canada, *Macoun*; Maine, *Miss White, Ricker, Murrill*; Connecticut, *Miss White*; New York, *Burnham, Earle*; New Jersey, *Ellis, Murrill*; Delaware, *Commons*; Pennsylvania, *Banker, Sumstine*; Virginia, *Murrill*; North Carolina, *Memminger*; Georgia, *Harper*; Tennessee, *Murrill*; Florida, *Lloyd*; Alabama, *Earle*; Louisiana, *Langlois*; Ohio, *Morgan*; Missouri, *Glatfelter*; Kansas, *Bartholomew*; Oregon, *Carpenter*.

2. BJERKANDERA FUMOSA (Pers.) Karst.

Boletus fumosus Pers. Syn. 530. 1801.
Polyporus fumosus Fr. Obs. Myc. **2**: 257. 1818.
Bjerkandera fumosa Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879.

This species appears to be fairly common throughout temperate regions on various forms of deciduous wood. Those who consider *Boletus imberbis* Bull., *Polyporus holmiensis* Fr. and *Polyporus salignus* Fr. forms of this species would undoubtedly include *Polyporus fragrans* Peck in the same category. The typical plant has round regular pores, more or less smoky, especially when bruised, and usually splitting with age. Among the numerous foreign and American specimens, the following may be mentioned:

Austria, *Bresadola*; Scotland, *Berkeley*; England, *Plowright*; Canada, *Macoun, Dearness*; New York, *Shear*; New Jersey, *Murrill*; Pennsylvania, *Everhart, Sumstine*; Delaware, *Commons*; Virginia, *Murrill*; Ohio, *Morgan*; Kansas, *Bartholomew*; Missouri, *Demetrio*; Iowa, *Holway*; Nebraska, *Webber*; Montana, *Anderson.*

3. Bjerkandera fragrans (Peck)

Polyporus fragrans Peck, Rep. N. Y. State Mus. **30**: 45. 1878.

Described from specimens collected on decaying trunks of elm trees near Bethlehem, New York, in October. The following note is appended to the description: "This species is closely related to *P. adustus* and *P. fumosus*, from which it is readily separated by the unequal pores. Its odor when fresh is very decided and quite agreeable, being not much unlike that of dry Seneca grass."

In a later report Peck says: "After heavy rains this fungus has a moist brownish appearance tinged slightly with dull red, and is obscurely zonate. It is paler when dry and sometimes slightly spotted. It is very closely allied to *P. fumosus*, and perhaps ought to be considered a mere variety of it. It is distinguished by its agreeable odor and by the thinner and sometimes lacerated dissepiments of its more unequal and angular pores."

Since Peck first described it, specimens have been collected on several other deciduous hosts beside elm and in many other states beside New York and Vermont, as the following will show: Canada, *Macoun, Dearness*; Vermont, *Morgan, Brainerd*; New York, *Peck, Cook, Miss Overacker*; New Jersey, *Cardiff*; Kansas, *Swingle, Cragin, Bartholomew*; Missouri, *Demetrio*; Wisconsin, *Baker*; Nebraska, *Webber*; Michigan, *Langdon.*

SPECIES INQUIRENDAE

POLYPORUS TEREBRANS B. & C. Jour. Linn. Soc. Bot. **10**: 306. 1868. Collected by Wright on dead trees in Cuba and thus described:

"Pileo subcarnoso, crasso, convexo, flabelliformi, luteo, pubescenti-scabro; stipite crasso lateraliter compresso, matrici pro magna parte, immerso, pubescente; pileo concolore; hymenio convexo, albido; poris parvis, acie obtusis.

"Pileus 1½ inch long, 1¾ wide; stem ¾ inch long and thick; pores $\frac{1}{84}$ inch across, probably much contracted."

Only one poor specimen is to be found at Kew, which resembles *Piptoporus suberosus* in general form. The stipe appears abnormal as though the result of an effort on the part of the sporophore to escape from the substratum. The hymenium is now quite dark in color.

POLYPORUS ALBOSTYGIUS B. & C. Jour. Linn. Soc. Bot. **10**: 309. 1868. Described from plants collected by Wright on dead wood in Cuba as follows:

"Pileo e resupinato breviter reflexo tomentoso pallido, margine pulvinato; hymenio nigro; poris minimis punctiformibus intus contextuque albis."

"Pileus with pores 2 lines thick; pores 1/180 inch in diameter, angular under a high magnifier. A very curious species."

The type specimens at Kew are white above and within, while the mouths of the tubes are very black. The name is well chosen.

TRAMETES Fr. Gen. Hym. 11. 1836

This genus was established upon *Polyporus suaveolens* and its allies, constituting one group, and *Daedalea gibbosa, D. elegans, D. rubescens*, etc., constituting a second subdivision. *Polyporus suaveolens* is the type. The genus is characterized by Fries as follows:

"Hymenophorum omnino immutatum et cum pilei substantia concolor inter poros descendit. Pori rotundati aut lineares, acie crassa et obtusa distincti, simplices, integerrimi, numquam laceri. Pileus suberosus."

Synopsis of the North American species

Pores small, round, thick-walled; plant white, very fragrant, only slightly yellowish on drying. 1. *T. odora.*

Pores much larger, 5 to 10 to a cm., angular, thin-walled; plant not fragrant, deep fawn-colored when dry. 2. *T. unicolor.*

1. TRAMETES ODORA (Sommerf.) Fr.

Polyporus odorus Sommerf. Suppl. Fl. Lap. 275. 1826. — Fr. Elench. Fung. 90. 1828.

Trametes odora Fr. Epicr. 491. 1838.

Daedalea puberula B. & C. Grevillea **1**: 67. 1872.

This species was first described from Lapland as follows:

"Dimidiatus irregularisque, pileo glabro pallescente, poris rotundis albido-ochraceis. *Boletus* L. Fl. Lap. no. 522. In Salicibus Nordlandiae saltensis."

"Odore pergrato et forti aniseo memorabilis. Interstitia pororum lacerata apparebant, pori tamen integri rotundi."

The circumstances under which this species was established are not satisfactory. The author had young, poorly developed specimens, and he acknowledges that Linnaeus' plant, *B. suaveolens*, was unknown to him, hence he, as well as Linnaeus, may have confounded the two species. However, specimens sent by him to Fries were considered distinct and his name was taken up as a varietal name under *P. suaveolens* in the Elenchus. Other contemporary botanists seem to have concurred in this view of the matter.

The species is certainly very near to *P. suaveolens* and was considered the same by Linnaeus. It has been reported only on willow from the northern parts of Europe and Asia. On comparing North American plants collected on willow with specimens at Kew and other foreign herbaria, it appears that they are all *T. odora*, differing from the Southern European species in being at first pubescent and at length smooth, with minor differences in context and pores. From what we know of distribution in the northern hemisphere, we should expect to find the more northerly species continuous around the globe.

Very few specimens are to be found in the herbarium here, although the plant is certainly not rare on willow in this country and its appearance is well known to most collectors. The following specimens are at hand: Maine, *Harvey;* New Hampshire, *Wilson;* Vermont, *Burt;* New York, *Underwood, Shear, Banker, Peck;* New Jersey, *Ellis;* Pennsylvania, *Gentry.* Accompanying the specimens collected recently by Banker was the following excellent field diagnosis:

"Odor of anise. First growing from the side of standing and then from fallen dead willow. In each case hymenium horizontal. Plant dimidiate, sessile, spreading to some extent beneath the prostrate log. Whitish throughout, becoming gray with age. Upper surface pubescent. Substance solid, tough, subwatery, elastic, resembling somewhat *Piptoporus suberosus;* stratified, the new growth continuous from the upper side of pileus around margin and over the hymenium. In old specimens these layers can be peeled off as in an onion."

2. **Trametes unicolor** (Schw.)

Boletus unicolor Schw. Syn. Fung. Car. 71. 1818.
Polyporus unicolor Fr. Epicr. 458. 1838.
Polyporus obtusus Berk. Ann. Mag. Nat. Hist. **3**: 390. 1839.

This species was collected in quantity on the trunks of living trees in North Carolina and described by Schweinitz very fully. According to him it is always to be found about half way up the trunk. I have found it in this position quite frequently on the trunks of shade trees in Washington, D. C.

Berkeley's description was taken from specimens in the Hooker herbarium collected in North America by Drummond and labeled *P. Drummondii* by Klotzsch. Comparison of the type specimens at Kew and Philadelphia shows the two species *P. unicolor* and *P. obtusus* to be synonymous. Either name is a very suitable one.

This is a large and conspicuous plant, but rather hard to collect on account of its arboreal habit. It has been found on dead or partly decaying living trunks of oak, maple and a few other deciduous trees. The pileus is quite soft and elastic when young and the tubes are very long and become somewhat daedaleoid by confluence as they grow older. Although abundant and well known in some localities, the species has not been often reported: New Jersey, *Ellis*, *Meschutt;* Maryland, *Maxon;* District of Columbia, *Murrill;* Virginia, *Murrill;* North Carolina, *Schweinitz;* Missouri, *Demetrio;* Iowa, *Holway;* Wisconsin, *Baker.*

SPECIES INQUIRENDAE

SISTOTREMA SPONGIOSUM Schw. Syn. Fung. Car. 75. 1818. *Polyporus labyrinthicus* Fr. Elench. Fung. 83. 1828. Described from North Carolina plants collected on living or recently fallen trunks. Discussed at some length by Fries, who received specimens from Schweinitz. In their commentary, Berkeley and Curtis say it is remarkable for its coarse, tow-like texture, but they do not associate it with any better known name or species.

There are many reasons for believing this species to be a near ally of *P. unicolor.* All the descriptions point to an old specimen of this latter plant in which the tubes have become quite daedaleoid and the dissepiments broken up. A sheet of specimens at Kew labeled *P. labyrinthicus* from Plowright's herbarium shows well the characters of *P. unicolor.* They may not be authentic, however, though they seem old enough to be so considered. On the same sheet at the bottom are the specimens of *P. leucospongia* sent from Harkness with their original label, *P. labyrinthicus*, just as he sent them. These are the cause of the confusion of the two species, as we see it in Saccardo's Sylloge, for example.

POLYPORUS TOMENTOSO-QUERCINUS Johnson, Bull. Minn. Acad. Nat. Sci. **1**: 338. 1878. Described from the author's collections in Minnesota as follows:

"Pileus at first soft, compact, spongy, tomentose, pulvinate, dimidiate, sessile, very thick, divergently fibrous within, broad surface of attachment, dirty grayish white when young, pale straw or subferruginous when old, hard, coriaceous, woody at maturity; pores large, irregular, toothed or fringed, easily separated, from ¾ to 1 inch long, varying in color from straw to bright orange."

"Nearly always on the north side of living oaks. Pileus 1 to 2 inches thick, 2 to 5 inches broad. Spores numerous, white, globose, very small. Drops its spores in May or early June. Plant is persistent, lasting the whole year. * * * Very scarce, only seen occasionally."

The above description applies very well to the western form of *Trametes unicolor*. It is necessary, however, to see the type plants before definitely connecting the two forms.

CORIOLUS Quél. Ench. Fung. 175. 1886

Hansenia Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. Not *Hansenia* Turcz. 1844.

The genus *Hansenia* was founded upon *Hansenia hirsuta* (Wulf), with seventeen additional species, and thus described:

"Receptaculum pileatum, dimidiatum, sessile, primitus aridum et firmum. Pileus cuticula tenui, fibrosa, coriaceus, villosus, zonatus, contextu floccoso, tenaci. Hymenium homogeneum. Pori trama pilei distincti ejusque substantiae verticaliter oppositi, subrotundi."

Unfortunately, the name *Hansenia* had been proposed by Turczaninow as early as 1844 (Bull. Soc. Nat. Mosc. **17**: 754) for a genus of the *Umbelliferae* and is consequently ineligible, leaving the vacancy to be filled by *Coriolus* of Quélet, founded upon *Polyporus zonatus* Fr. and seven other species, with the following description:

"Pileus villosus, zonis concentricis, vulgo discoloribus, fasciatus. Spora oblonga, alba. Lignatiles."

Polyporus lutescens Pers., the first species listed by Quélet under *Coriolus*, is accompanied by the citation of a figure, but this citation was but doubtfully given by Persoon in the original description and the recent investigations of Bresadola, who has examined Persoon's types, do not tend to confirm Quélet's opinion. The type of *Coriolus*, therefore, is *P. zonatus*, the first species accompanied by a correct citation of a figure.

The species of this genus are mostly thin, dry plants with a more or less zonate surface, which may be glabrous or variously adorned with hairs. White or yellowish colors prevail for both surface and context, only a few species showing light-brown or gray tints. The hymenium becomes wholly or partially fuscous in a few species, but it is generally white. The tubes are small and delicate, often breaking up with age. In some species there is an early fission of the dissepiments and the hymenium becomes irpiciform, as in the very common *Coriolus pargamenus.*

Work in this entire group has been rendered exceedingly difficult by the large number of "new species" published independently in former years from three or four European centers of research, each ignoring the existence of the rest. In the case of the present genus, these brief early descriptions are entirely inadequate and the poorly preserved type plants, when they exist at all, often fail to supplement them sufficiently.

Add to this the host of incorrect determinations found in the literature then current, the wholesale assignment of foreign names to plants exclusively American, and the glittering array of species in important herbaria combined under one name, and the systematist confronts a set of conditions unusually stringent where plants naturally closely allied are to be distinguished and new species described.

Synopsis of the North American species

1. Tubes more or less entire, at least until the sporophore is quite old. 2.
   Tubes soon breaking up into long irpiciform teeth. 24.
2. Surface of pileus wholly or partly glabrous when mature or clothed only with inconspicuous hairs. 3.
   Surface of pileus clothed entirely with a very conspicuous hairy covering. 18.
3. Pileus not entirely glabrous at maturity. 4.
   Pileus entirely glabrous at maturity. 10.
4. Pileus marked at maturity with glabrous zones of a different color from the rest of the surface. 5.
   Pileus not marked with glabrous zones, but nearly uniform in color and not shining. 9.
5. Glabrous zones large, numerous, conspicuously and variously colored. 1. *C. versicolor.*
   Glabrous zones small and comparatively inconspicuous. 6.
6. Surface villose between the zones, which are late in appearing; plants small, 1–2 cm. in diameter. 2. *C. hirsutulus.*
   Surface minutely pubescent or tomentose between the zones; plants usually much larger. 7.
7. Hymenium white or yellowish. 8.
   Hymenium fuscous. 3. *C. floridanus.*

8. Tubes small, 5 to a mm., and perfectly regular and entire. 4. *C. ectypus.*
Tubes twice as large, often irregular from splitting; glabrous zones late in appearing and sometimes absent. 5. *C. pubescens.*
9. Sporophore semiresupinate, shortly reflexed, tubes 1 cm. or more in length. 6. *C. subluteus.*
Sporophore wholly pileate, tubes less than 1 cm. in length. 7. *C. Sartwellii.*
10. Plants white or very light-colored. 11.
Plants more or less gray or brown. 16.
11. Hymenium lilac-colored, often faded in herbarium specimens. 8. *C. brachypus.*
Hymenium white or yellowish. 12.
12. Margin of pileus entire or lobed, not becoming fimbriate or lacerate. 13.
Margin of pileus very thin, becoming fimbriate or lacerate at maturity. 14.
13. Sporophore extremely thin and very flexible, with only one or two, if any, shining zones. 9. *C. haedinus.*
Sporophore thicker and quite rigid, with several shining zones. 10. *C. ilicincola.*
14. Tubes large, 2–3 to a mm., margin fimbriate. 11. *C. Drummondii.*
Tubes only half as large, margin lacerate. 15.
15. Sporophore dimidiate. 12. *C. membranaceus.*
Sporophore elongated, spatulate. 13. *C. Flabellum.*
16. Pileus marked with brown and black zones; temperate species. 14. *C. planellus.*
Pileus marked with brown and tawny zones; tropical species. 17.
17. Tubes 5 to a mm.; pileus 5 cm. broad, pale tawny, with darker brown zones; velvety zones present in young stages seem soon to disappear. 15. *C. armenicolor.*
Tubes 3 to a mm.; pileus 3 cm. broad, umbrinous-cinereous, subzonate. 16. *C. sobrius.*
18. Pileus 0.5 cm. or more in thickness and several centimeters wide. 19.
Pileus much thinner. 20.
19. Dissepiments obtuse, margin broadly sterile below. 17. *C. nigromarginatus.*
Dissepiments acute, margin but slightly sterile below. 18. *C. Sullivantii.*
20. Hymenium becoming wholly or partly fuscous, tubes broad and very shallow. 21.
Hymenium not becoming fuscous. 22.
21. Tubes regular in shape and size; plant tropical. 19. *C. pinsitus.*
Tubes irregular both in shape and size; plant confined to the southern United States. 20. *C. sericeohirsutus.*
22. Tubes large, 2–3 to a mm. 23.
Tubes small, 5 to a mm. 21. *C. arenicolor.*
23. Edges of tubes entire. 22. *C. hirtellus.*
Edges of tubes thin, serrate. 23. *C. tener.*
24. Plants large, 6–20 cm. wide and about 1 cm. in thickness. 24. *C. biformis.*
Plants much smaller and always very thin. 25.
25. Surface ashy-white, villose; plant confined to coniferous wood. 25. *C. abietinus.*
Surface wood-colored, tomentose; plant found on both deciduous and coniferous wood. 26. *C. pargamenus.*

1. CORIOLUS VERSICOLOR (L.) Quél.

Boletus versicolor L. Sp. Pl. 1176. 1753.
Polyporus versicolor Fr. Syst. Myc. 1: 368. 1821.

Polystictus azureus Fr. Nov. Symb. 93. 1851.
Coriolus versicolor Quél. Ench. Fung. 175. 1886.

Described originally by Haller from plants collected in Switzerland. Several other specific names have been given to European forms which need not be mentioned here. *P. azureus* was assigned by Fries to a thin, beautifully colored form collected at Mirador, Mexico, by Liebmann. It is no more distinct than a dozen other forms which might be mentioned and should receive similar treatment with them.

This species is cosmopolitan and exceedingly abundant on all forms of dead deciduous wood. Although numerous variations occur in its wide range, some of them sufficiently distinct, it seems, for specific rank, still the difficulty of going through the large accumulations of material from all lands in the different herbaria and satisfactorily separating it into groups is so great that it will probably not soon be attempted, especially since the species is so well defined by definite and easily observed characters.

Specimens have been examined from many widely different localities. Living plants have been observed throughout Europe and various parts of the United States. It is needless to attempt here a summary of collections at hand.

2. **Coriolus hirsutulus** (Schw.)

Polyporus hirsutulus Schw. Trans. Am. Phil. Soc. **4**: 156. 1834.

Described from plants collected at Bethlehem, Pennsylvania, on trunks of trees, as follows:

"P. minutus, dimidiatus aut reniformis, subinfundibuliformis etiam; substipitatus, coriaceus, ½ uncialis. Pileo strigoso-canescente griseo, fasciis notato ex pilis setosis, fuligineo-nigris, aggregatis in centro et in margine inflexo, inde ciliato. Poris pallidis subdecurrentibus."

This species is rather common on dead branches of *Sassafras* and is found more rarely on other forms of deciduous wood. One collection of it has been made also on white cedar. Authentic plants may still be seen in the Schweinitz herbarium. They resemble young sporophores of *C. versicolor* in which the zones have just begun to appear, but they are quite distinct from this species and more nearly allied to depauperate forms of *C. nigromarginatus*. The limits of the species need to be better understood. *Polystictus Fibula* Fr. is a close ally.

Material is at hand from Canada, *Macoun;* Connecticut, *Earle;* New York, *Earle;* Pennsylvania, *Michener;* New Jersey, *Ellis;* Ohio, *James*, *Morgan*.

3. CORIOLUS FLORIDANUS (Berk.) Pat.

Polyporus floridanus Berk. Ann. Mag. Nat. Hist. **10**: 376. 1843.
Polystictus Oniscus Fr. Nov. Symb. 82. 1851.
Coriolus floridanus Pat. Tax. Hymén. 94. 1900.

Described by Berkeley from specimens collected on decaying deciduous trunks in Florida. Described from Mexico and South Carolina by Fries in 1841, but not published until ten years later. Although Fries considered his plant distinct from Berkeley's, they cover the same territory and appear difficult to separate specifically.

This species occurs on oak logs and other deciduous wood in the southern United States from South Carolina to Florida and along the Gulf of Mexico to Texas. It much resembles *C. pargamenus* both in form and habit, but is readily distinguished by its grayish slate-colored surface and smoky hymenium. In some foreign herbaria it is confused with *Polystictus Friesii* Kl., a related species described from tropical America.

Specimens are at hand from South Carolina, *Ravenel;* Florida, *Ravenel*, *Martin*, *Lloyd*, *Small & Carter 1324*, *E. G. Britton 445;* Louisiana, *Langlois;* Texas, *Ravenel*.

4. CORIOLUS ECTYPUS (B. & C.) Pat.

Polyporus ectypus B. & C. Grevillea **1**: 52. 1872.
Coriolus ectypus Pat. Tax. Hymén. 94. 1900.

The type plants of this species were collected by Ravenel in South Carolina. It has since been found in other parts of the southeastern United States on decayed deciduous wood of various kinds. The following field notes made by Calkins in Florida are of interest as supplementing the rather brief published description:

"Tough, coriaceous, elastic, nearly plane, yellowish and nearly smooth above and multizonate with concentric, very shallow zones; 3–4 inches across, 1/4 inch thick, margin acute, sterile beneath. Pores pallid-white changing to yellowish, especially around the margin, small, round, or in places distinctly sinuous, with a changeable luster, even on the surface and not at all lacerate, 2–3 millimeters long. Smell acid; plant somewhat juicy and moist when fresh."

Specimens are at hand from South Carolina, *Ravenel;* Georgia, *Ravenel;* Florida, *Rau, Martin, Calkins;* Louisiana, *Langlois.*

5. **Coriolus pubescens** (Schum.)

Boletus pubescens Schum. Enum. Pl. Saell. **2**: 384. 1803.
Polyporus pubescens Fr. Obs. Myc. **1**: 126. 1815.
Leptoporus pubescens Pat. Tax. Hymén. 84. 1900.

Originally described, from plants collected on white birch in Sweden in midsummer, as follows:

"Cespitosus, imbricatus, pileo carnoso-suberoso, pulvinato, pubescenti, sericeo, albo, undulato-tuberculoso, margineque acuto luteo subferrugineo subzonato; subtus planus albido-pallescens: poris minutis marginem versus evanescentibus: tubulis brevibus. Caro alba. Pileus 1½–2½ poll. latus, 2–3 lin. crassus."

The margin of the American plant is usually more abrupt than that of the European, but the two agree too closely to allow of specific separation. Our plant has been distributed as a variety by Ellis, who at first gave the name of the collector to plants brought from Michigan in 1881 by J. B. Gray, thinking he had a new species. Upon the advice of Cooke, however, the name was reduced to varietal rank before distribution. So far as I know, no description has been published by Ellis either of the species or the variety.

This same plant was collected in Ohio and determined by Morgan as *P. molliusculus* Berk. The Berlin "type" of *P. molliusculus* is from Morgan. Kellerman, following Morgan, has recently distributed the present species under the name of *Polystictus molliusculus* Berk., with a printed description evidently not in accord with the specimens.

This species is very common in the northern United States and Canada on decaying wood of birch, beech, alder, willow, poplar, etc. Dearness found it abundant on rotten beech trunks at London, Canada, but the sporophores were mostly eaten to the bark by squirrels. Material is at hand from the following American localities:

Canada, *Macoun, Dearness;* Maine, *Ricker, Murrill;* Vermont, *Burt;* Massachusetts, *Blake;* New York, *Shear, Peck, Under-*

wood, Maxon & House ; Ohio, *James, Lloyd, Kellerman ;* Iowa, *Holway, Macbride ;* Wisconsin, *Baker ;* Michigan, *J. B. Gray.*

6. **Coriolus subluteus** (Ell. & Ev.)

Polyporus subluteus Ell. & Ev. Am. Nat. **31**: 339. 1897.

Described from plants collected by Dearness on old beech trunks in Canada as follows:

"Effused; pileus white, with short tomentum, azonate, subimbricate, margin obtuse, context soft and flexible, upper margin more or less reflexed; pores subcolliculose, unequal, round or subsinuous, 1/3–3/4 mm. in diameter, 3/4–1 cm. long, subluteous when dry, white inside, margin subdentate, dissepiments thin, context white, not fibrous; spores oblong, very slightly pointed, white, $4–6 \times 1\frac{1}{2}–2\ \mu$."

The type collection of this species is now in the herbarium of the New York Botanical Garden. Too little is known of the plant to be sure that it is not an overgrown resupinate form of some other species.

7. **Coriolus Sartwellii** (B. & C.)

Polyporus Sartwellii B. & C. Grevillea **1**: 51. 1872.

Described from plants collected on trunks in New York by Sartwell. Specimens from New England collected by Sprague were also at hand. There is in the Ellis collection a box of plants collected at Potsdam, New York, in January, 1861, which agree perfectly with the types of *P. Sartwellii* now at Kew. These plants grew on hemlock logs. Specimens collected by Underwood on pine at Centerville, New York, in April, 1887, appear to be specifically identical and show the hymenium to be yellowish instead of black, as in the description, becoming dull-brown with age. Nothing further is known of the species unless Léveillé's brief description of *Polyporus subflavus* (Ann. Sci. Nat. Bot. III. **5**: 300. 1846), collected on trunks in New York by Sallé, refers to the same plant; and this is quite improbable.

8. **Coriolus brachypus** (Lév.)

Polyporus brachypus Lév. Ann. Sci. Nat. Bot. III. **5**: 127. 1846.
Polyporus albo-cervinus Berk. Hook. Jour. Bot. **8**: 234. 1856.
Coriolus albo-cervinus Pat. Tax. Hymén. 94. 1900.

This species was first described from plants collected on trunks in Guadeloupe by L'Herminier. Berkeley's name was assigned to specimens from Panuré, Brazil, collected by Spruce. He remarks that it differs from *Polystictus Didrichsenii* Fr. (Nov. Symb. 76. 1851), found on the island of Bora-Bora, in its far smaller pores.

The present species is easily known by reason of its beautiful lilac-colored hymenium. It is quite well distributed in tropical America on decayed hardwood trunks.

Surinam, *James;* Brazil, *Spruce;* Nicaragua, *C. L. Smith;* Honduras, *Wilson 179, 560, 670;* Porto Rico, *Wilson 202;* Florida, *Bertolet, Britton 449.*

9. CORIOLUS HAEDINUS (Berk.) Pat.

Polyporus haedinus Berk. Hook. Jour. Bot. **8**: 234. 1856.

Polyporus undigerus B. & C. Jour. Linn. Soc. Bot. **10**: 317. 1868.

Coriolus haedinus Pat. Tax. Hymén. 94. 1900.

Described as follows from Panuré, Brazil, collected on decaying trunks by Spruce:

"Albus, suborbicularis, postice decurrens, tenuis, papyraceus; pileo subtiliter pubescente sulcato-zonato; hymenio concolori; poris angulatis minutis; dissepimentis tenuibus."

"An elegant species, allied to *P. hirsutus*, but much thinner, with finer pores and destitute of distinct hairs."

Twelve years later, Berkeley described the same plant from Cuba under another name, using almost the same words.

10. **Coriolus ilicincola** (B. & C.)

Polyporus ilicincola B. &. C. Grevillea **1**: 52. 1872.

Described from specimens collected by Peters in Alabama on the bark of *Ilex opaca.* The types at Kew are not well preserved. Specimens in the Ellis collection agree in all respects except the sinuate pores.

11. CORIOLUS DRUMMONDII (Kl.) Pat.

Polyporus Drummondii Kl. Linnaea **8**: 487. 1833.

Coriolus Drummondii Pat. Tax. Hymén. 94. 1900.

The type plants were collected by Drummond on trunks near New Orleans, Louisiana. Klotzsch saw them in Hooker's herbarium. They are now in a fair state of preservation at Kew. The plant has not since been collected in Louisiana and I have not seen anything closely resembling it in recent collections from the southern United States.

Specimens collected in Brazil by Möller are referred to this species by Bresadola (Hedwigia **35**: 281. 1896) with the following notes: "Species haec vegeta ex integro alba, postice longe resupinato-producta, interdum ex integro resupinata. Sporae hyalinae, subglobosae, $5-6 \times 4-4\frac{1}{2}\ \mu$; hyphae subhymeniale $3\frac{1}{2}-4\frac{1}{2}\ \mu$ latae, septatae." The identity of the two plants is doubtful.

12. CORIOLUS MEMBRANACEUS (Sw.) Pat.

Boletus membranaceus Sw. Prodr. 148. 1788. — Fl. Ind. Occ. **3**: 1922. 1806.

Polyporus membranaceus Fr. Syst. Myc. **1**: 370. 1821. — Berk. Ann. Mag. Nat. Hist. **10**: 378. *pl. 10. f. 7.* 1843.

Polystictus semiplicatus Ell. & Macbr. Iowa Bull. Nat. Hist. **3**: 192. 1896.

Coriolus membranaceus Pat. Tax. Hymén. 94. 1900.

Originally described from plants collected on dead wood in Jamaica as follows:

"B. acaulis gregarius proliferus submembranaceus laevis radiatus albus, poris erosis difformibus."

This description is much enlarged in Swartz's later work. The species is exceedingly abundant in tropical America on all kinds of dead wood and large collections have been brought to the New York Botanical Garden in recent years, as the following list will show:

Porto Rico, *Earle, Underwood & Griggs, Heller, Wilson 39*; New Providence, *E. G. Britton 732*; St. Kitts, *Britton & Cowell 710*; Cuba, *Underwood & Earle 572, 853, 1318, 1374, 1376, 1575, Earle, Wilson, Murrill*; Jamaica, *Earle 232, 525, 601, 611, Underwood 2326, Miss Robinson*; Nicaragua, *Smith*; Colombia, *Baker*.

13. **Coriolus Flabellum** (Mont.)

Polyporus Flabellum Mont. Pl. Cell. Cuba. 388. *pl. 15. f. 2.* 1842.

Well described and finely figured by Montagne from plants collected on dead branches and trunks in Cuba. Types at Paris are well preserved. Although nearly related to *C. pargamenus*, it is quite distinct both in form and habit. It is more difficult to separate it from *C. membranaceus*.

14. **Coriolus planellus** nom. nov.

Polyporus planus Peck, Rep. N. Y. State Mus. Nat. Hist. **31**: 37. 1879. Not *P. planus* Wallr. 1833.

The type plants of this species were collected on dead branches at North Greenbush, New York. Only a few specimens are at hand: New Hampshire, *Blake*; Maine, *Murrill*; Iowa, *Holway*.

15. CORIOLUS ARMENICOLOR (B. & C.) Pat.

Polyporus armenicolor B. & C. Jour. Linn. Soc. Bot. **10**: 315. 1868.

Coriolus armenicolor Pat. Tax. Hymén. 94. 1900.

Described as follows from Wright's Cuban collections:

"Pileo tenui subcoriaceo flabelliformi in stipitem spurium attenuato zonato velutino interstitiis lineatis; hymenio alutaceo; poris minutis, dissepimentis tenuibus dentatis."

"On dead wood. Pileus 2½ inches across, 1¾ long; pores $\frac{1}{120}$ inch in diameter. The pileus is of a pale tawny or tan-color, with darker lines. Allied to *P. versicolor*."

Plants collected by Cockerell in Jamaica in 1890 correspond exactly with Wright's Cuban types at Kew except with respect to the zones of tomentum, which may be variable or evanescent in the species. More material may throw light on this matter.

16. **Coriolus sobrius** (B. & C.)

Polyporus sobrius B. & C. Jour. Linn. Soc. Bot. **10**: 316. 1868.

Described as follows from Wright's collections in Cuba:

"Pileo imbricato flabelliformi opaco glaberrimo subzonato tenui umbrino-cinereo nebuloso; poris parvis laceratis."

"On dead wood. Pileus $\frac{9}{8}$ inch wide, $\frac{5}{8}$ inch long; pores $\frac{1}{84}$ inch in diameter. Somewhat resembling *P. sector*, var. *zonarius*, but, I think, distinct."

The small thin purplish zonate type plants now at Kew appear quite distinct.

17. **Coriolus nigromarginatus** (Schw.)

Boletus hirsutus Wulf. in Jacq. Collect. **2**: 149. 1788. Not *Boletus hirsutus* Scop. Fl. Carn. ed. 2. **2**: 468. 1772.

Boletus nigromarginatus Schw. Syn. Fung. Car. 72. 1818.

Polyporus hirsutus Fr. Syst. Myc. **1**: 367. 1821.

Originally described from plants collected in Carinthia, where Wulfen found it very common on tree trunks in the forests and sometimes in orchards. His following brief description is accompanied by copious notes:

"Boletus acaulis, semicircularis, plano-convexus, albissimus, supra hirsutissimus, lineis concentricis alternis depressis; subtus poris rotundato-angulatis."

Wulfen's name, however, is preoccupied by Scopoli for the plant usually known as *Polyporus hispidus* Fr. (see Bull. Torrey Club **31**: 594. 1904) and Schweinitz's name must be used for the present species. It was first applied to specimens collected on trunks of *Liriodendron* in North Carolina and afterwards on the same host in Pennsylvania, to which host Schweinitz thought it was confined.

It must be confessed that this form on *Liriodendron* looks distinct when seen in the field, being large and rigid, with short tomentum and a broad black marginal band; but I am convinced that this is an undeveloped stage, deserving possibly varietal, but not specific, distinction. Type plants in the Schweinitz herbarium appear fully developed and not at all unlike ordinary forms on other deciduous trees.

This species is very abundant throughout the United States and Canada on all kinds of decaying deciduous wood, the form on *Liquidambar* especially being very similar to that from the European type locality. In early summer the sporophores make their appearance as very dark brown hairy swellings on decayed wood or the remains of older pilei and grow rapidly into conchate fruit-bodies of tough elastic substance and hirsute surface marked with concentric zones of gray and brown. The hymenium may be yellowish or fuscous and the pores circular or irregular, with thin, dentate dissepiments equaling the thickness of the context in length. No shining glabrous zones make their appearance as is the case with *C. versicolor.*

Specimens too numerous to mention here have been examined from various parts of Europe, Asia and North America.

18. **Coriolus Sullivantii** (Mont.)

Polyporus Sullivantii Mont. Ann. Sci. Nat. Bot. II. **18**: 243. 1842.

Described from plants collected on fallen dead branches in Ohio by Sullivant and sent to Montagne by Asa Gray. Little is known of the species. Two collections made by Ellis in New York match the types at Kew. The pileus is orbicular to dimidiate, thin, coriaceous, concave beneath, with acute margin and villose, zonate surface. The tubes are unequal, of medium size, a millimeter or more in length, with acute, dentate dissepiments, which become pale fuscous with age. There is little to distinguish it from forms of *C. hirsutus*.

19. CORIOLUS PINSITUS (Fr.) Pat.

Polyporus pinsitus Fr. Elench. Fung. 95. 1828.
Polystictus umbonatus Fr. Nov. Symb. 87. 1851.
Coriolus pinsitus Pat. Tax. Hymén. 94. 1900.

Collected by Lund on trunks of trees in Brazil and described as follows:

"Coriaceo-membranaceus, tenax, pileis hirtis concentrice sulcatis unicoloribus cinereis, poris curtis majusculis angulatis acutis inaequalibus albis."

Later described as *Polystictus umbonatus* from Liebmann's Mexican collections on account of the dark pores seen in these specimens. The hymenium varies from white to purple and smoke-colored in a way calculated to puzzle anyone not accustomed to its changes. Some specimens are half white and half dark beneath.

Few species are more abundant than this in tropical America. It may be found on dead wood of various forms and kinds, such as sticks, stumps and logs of bamboo, logwood, cocoanut, etc., throughout the West Indies and the warmer parts of Central and South America. The following list includes numbers of specimens recently added to the New York Botanical Garden herbarium:

Bolivia, *Rusby;* Ecuador, *Lagerheim*; Brazil, *Henschen, Lund;* Venezuela, *Gaillard;* Nicaragua, *Smith;* Mexico, *Liebmann, Smith;* Cuba, *Wright, Earle, Wilson, Murrill, Underwood & Earle 1117, 1482, 1503, 1509, 1517, Britton & Shafer 469, 473, 558, 774;* Jamaica, *Earle 95, 133, 135, 140, 159b, 231;* Porto Rico, *Goll, Earle 22, 43;* New Providence, *E. G. Britton 722;* Southern Florida, *E. G. Britton 465, Small & Carter 1331.*

20. **Coriolus sericeohirsutus** (Kl.)

Polyporus sericeo-hirsutus Kl. Linnaea **8**: 483. 1833.
Hexagona sericea Fr. Epicr. 497. 1838.

Polystictus barbatulus Fr. Nov. Symb. 87. 1851.

Described by Klotzsch from North American specimens in the Hooker herbarium. The type collection of *Polystictus barbatulus* was made by Curtis in South Carolina on dead trunks of red cedar. Fries separated it from *Hexagona sericea* because of its large pores, not knowing that this species shows wide variation in the form and size of its tubes. The resupinate depauperate form is incorrectly called *Poria superficialis* of Schweinitz in the Fries herbarium.

This plant is distinct, easily recognized and confined to one host, *Juniperus virginiana*, on the dead trunks and branches of which it is quite common in the southern United States north to Virginia and west to Missouri. I have collected it in quantity near Elizabethtown, Tennessee.

Specimens have been examined from South Carolina, *Ravenel;* Georgia, *Ravenel;* Florida, *Rau, Calkins, Lloyd;* Louisiana, *Langlois;* Tennessee, *Murrill 456;* Kentucky, *Miss Price;* Missouri, *Demetrio.*

21. **Coriolus arenicolor** (B. & C.)

Polyporus arenicolor B. & C. Jour. Linn. Soc. Bot. **10**: 315. 1868.

Described as follows from Wright's collections in Cuba:

"Pileo dimidiato postice decurrente papyraceo repetite zonato strigoso velutino, pallido, margine lobato; poris parvis angulatis, dissepimentis tenuibus; hymenio ochraceo."

"On logs in woods. Pileus 3 inches wide, 1¾ long. Pores $\frac{1}{100}$ inch across. Allied to *P. pinsitus* rather than to *P. hirsutus.*"

This is a very abundant species throughout the West Indies, on dead sticks and logs of various broad-leaved trees. It has been confused with *C. velutinus* and with *C. haedinus,* from both of which it is quite distinct. Material is at hand from the following localities:

Cuba, *Earle, Wilson, Pollard, Murrill, Underwood & Earle 379, 571, 763, 1503;* Haiti, *Nash 25;* Jamaica, *Earle 24, 48, 60, 92, 138, 157, 159a, 336, 340, 486;* New Providence, *E. G. Britton 245, 730;* Southern Florida, *Small & Carter 1322.*

22. **Coriolus hirtellus** (Fr.)

Polystictus hirtellus Fr. Nov. Symb. 83. 1851.

Collected on trunks of trees in Mexico by Liebmann and described as follows:

"Pileo stuppeo-coriaceo effuso-reflexo, pilis subtilibus erectis strigosis hirtulo, primitus azono, demum versus marginem obsolete et concolori-sulcato, contextu albido, poris mediis rotundis angulatisque helvelo-pallidis, demum fuscescentibus."

The types are poorly preserved and difficult to distinguish from old plants of *C. nigromarginatus* or *Coriolopsis occidentalis.*

23. **Coriolus tener** (Lév.)

Polyporus tener Lév. Ann. Sci. Nat. Bot. III. **5**: 139. 1846.

Described from plants collected on trunks in Guadeloupe by L'Herminier as follows:

"Pileo coriaceo reflexo membranaceo sessili orbiculari zonato hirsuto albo, margine ancipiti subtus sterili, poris hexagonis ore acutis intus extusque alutaceis, contextu albo."

"Chapeau quelquefois résupiné, mais le plus ordinairement réfléchi, large de 2 ou 3 centimètres, membraneux, flexible, à surface blanche, tomenteuse; pores d'un jaune tendre."

The types are at Paris. Very little is known of the species, though it appears distinct.

24. CORIOLUS BIFORMIS (Kl.) Pat.

Polyporus biformis Kl. Linnaea **8**: 486. 1833.
Polyporus molliusculus Berk. Lond. Jour. Bot. **6**: 320. 1847.
Polyporus carolinensis Berk. Hook. Jour. Bot. **1**: 102. 1849.
Polyporus chartaceus Berk. Hook. Jour. Bot. **1**: 103. 1849. — Grevillea **1**: 53. 1872.
Coriolus biformis Pat. Tax. Hymén. 94. 1900.

Originally described from specimens collected by Dr. Richardson on birch in North America as follows:

"Pileo effuso-reflexo coriaceo villoso candido zonato, poris mediis dentatis albidis. Imbricatus. Pileus 2–4 unc. latus, 1–2 unc. longus. Pori irregulares, interdum fusco-violascentes."

Polyporus molliusculus was described from Lea's collections in Ohio, *P. carolinensis* from plants collected by Curtis on oak and *Liquidambar* in South Carolina and *P. chartaceus* from specimens found by Curtis in North Carolina on the under side of fallen trunks and branches of *Liriodendron.* According to Berkeley and Curtis, *Irpex epiphylla* Schw. is also a synonym.

This species is common, widely distributed and conspicuous on various forms of dead deciduous wood throughout North America, being usually referred to by collectors under its earliest name, with *P. carolinensis* and *P. chartaceus* as synonyms. *P.*

molliusculus is here thrown into synonymy only after a careful examination of the original specimens, which fully warrant this disposition of a troublesome name.

Specimens are at hand from Canada, *Dearness*; New Hampshire, *Miss Minns*; New York, *Murrill*; New Jersey, *Ellis*; Delaware, *Commons*; Pennsylvania, *Barbour*; West Virginia, *Nuttall*; Florida, *Calkins*; Alabama, *Benson, Underwood, Earle*; Louisiana, *Langlois*; Ohio, *Lloyd*; Missouri, *Demetrio*; Kansas, *Cragin*; Iowa, *Macbride*.

25. CORIOLUS ABIETINUS (Dicks.) Quél.

Boletus abietinus Dicks. Pl. Crypt. Brit. **3**: 21. *pl. 9. f. 9.* 1793.
Boletus incarnatus Schum. Enum. Pl. Saell. **2**: 391. 1803.
Coriolus abietinus Quél. Ench. Fung. 175. 1886.

A good description of this plant is to be found in the Magazin für Botanik **12**: 19. 1790, presumably written by Schrank, but I hesitate to ascribe the species to him on the basis of this citation. It seems quite certain that *Sistotrema fuscoviolaceum* Pers. is a form of the present species; and, according to Bresadola, *P. caesioalbus* Karst. is not specifically distinct.

This species has been well known for a long time by reason of its abundance throughout the northern hemisphere on decaying wood of coniferous trees, none of which appear to be exempt from its attack. Of the large number of specimens examined, the following may be mentioned:

Finland, *Karsten*; Tyrol, *Bresadola*; Newfoundland, *Waghorne*; Canada, *Macoun*; New York, *Shear, Underwood, Peck*; New Jersey, *Ellis*; South Carolina, *Ravenel*; Georgia, *Harper*; Alabama, *Mell*; Cuba, *Underwood & Earle 1337*; Texas, *Ravenel*; California, *McClatchie*; Colorado, *Bethel*.

26. CORIOLUS PARGAMENUS (Fr.) Pat.

Polyporus parvulus Schw. Trans. Am. Phil. Soc. **4**: 157. 1834.
Not *P. parvulus* Kl. Linnaea **8**: 483. 1833.
Polyporus pargamenus Fr. Epicr. 480. 1838.
Polyporus laceratus Berk. Ann. Mag. Nat. Hist. **3**: 392. 1839.
Polyporus Menandianus Mont. Ann. Sci. Nat. Bot. II. **20**: 362. 1843.

Polyporus xalapensis Berk. Hook. Jour. Bot. **1**: 103. 1849.

Polyporus balsameus Peck, Rep. N. Y. State Mus. Nat. Hist. **30**: 46. 1878.

Polyporus pseudopargamenus Thüm. Myc. Univ. no. 1102.

Polystictus Pusio Sacc. & Cub. in Sacc. Sylloge Fung. **6**: 265. 1888.

Coriolus pargamenus Pat. Tax. Hymén. 94. 1900.

Originally described under the name in current use from specimens collected by the Franklin expedition on trunks of pine in arctic North America. A year or two later Berkeley described it from New Orleans, Louisiana, under the name of *Polyporus laceratus*; then Montagne found it among Menand's New York collections and gave it the name of the collector. If the form on conifers is specifically distinct from that on deciduous wood, then *Polyporus balsameus* Peck is a synonym of *P. parvulus* Schw. and *P. pargamenus* Fr., while *P. laceratus* holds for the form on oak, chestnut, etc. After examining growing specimens of both forms, however, I think it best to consider them specifically the same.

The above list does not complete the synonyms of this variable plant. According to Bresadola, *Polyporus dispar* Kalchbr. and *Polyporus simulans* Blonski should be added for the European forms; while there are probably half a dozen more from other regions. Specimens from North America have been variously determined as *P. elongatus* Berk., described from Manila, *P. nilgheriensis* Mont., described from India, and *Daedalea ferruginea* Schum., described from Denmark.

This species occurs in great abundance in North America on dead wood of oak, cherry, birch, chestnut, maple and other deciduous trees, often covering the sides of dead standing or fallen trunks, especially those of white oak, for almost their entire length. It is also found on pine, hemlock, fir, etc., especially in the northern forests where these trees abound, the typical host of both the Schweinitzian and Friesian plants having been a pine trunk.

It also occurs in Europe, where it appears to have been recognized only recently under its Friesian name. Bresadola reports it common in Hungary on poplar, oak and basswood and considers it cosmoplitan in one or more of its multiplied forms.

The following list of specimens examined is much abbreviated and deals almost wholly with American material: Maine, *Ricker, Murrill, Miss White;* Connecticut, *Miss White;* New York, *Peck, Underwood, Clinton, Murrill;* New Jersey, *Ellis, Britton, Murrill;* Delaware, *Commons;* Pennsylvania, *Stevenson, Barbour, Sumstine, Murrill;* Virginia, *Murrill;* South Carolina, *Ravenel;* Georgia, *Harper;* Florida, *Nash;* Louisiana, *Langlois;* Tennessee, *Murrill;* Wisconsin, *Baker;* Hungary, *Kmet.*

SPECIES INQUIRENDAE

Polyporus arcticus Fr. Epicr. 479. 1838.
Boletus cervinus Schw. Synop. Fung. Car. 70. 1818.
Boletus cinerascens Schw. Synop. Fung. Car. 73. 1818.
Polystictus cyphelloides Fr. Nov. Symb. 88. 1851.
Polyporus decipiens Schw. Trans. Am. Phil. Soc. **4**: 157. 1834.
Polystictus deglubens Cooke, in Sacc. Syll. Fung. **6**: 290. 1888.
Polyporus Friesii Kl. Linnaea **8**: 487. *pl. 11.* 1833.
Polystictus jamaicensis Henn. Hedwigia **37**: 280. 1898.
Polyporus Kickxianus Lév. Ann. Sci. Nat. Bot. III. **9**: 122. 1848.
Polystictus limitatus B. & C. Grevillea **1**: 54. 1872.
Polystictus nuceus Fr. Nov. Symb. 81. 1851.
Polyporus papyraceus Fr. Elench. Fung. 97. 1828.
Polystictus placentaeformis Cooke, Grevillea **15**: 24. 1886.
Polystictus Ravenelii Berk. & Fr. Nov. Symb. 82. 1851.
Polyporus Richardsonii B. & C. Jour. Acad. Sci. Phila. II. **3**: 224. 1856.
Polyporus scarrosus B. & C. Grevillea **1**: 52. 1872.
Polyporus subflavus Lév. Ann. Sci. Nat. Bot. III. **5**: 300. 1846.

NEW YORK BOTANICAL GARDEN.

Astragalus and its segregates as represented in Colorado

PER AXEL RYDBERG

Linnaeus had two genera, *Astragalus* and *Phaca*, the former with a 2-celled, coriaceous or membranous pod and the latter with a 1-celled, papery pod. As more species have become known these characters do not hold, as there are many species which have the pods partly 2-celled, and the texture of both the 1-celled and 2-celled pods varies. The only reasonable ways to treat these two genera, are to merge them into one or to divide them into several. The latter was tried by Torrey and Gray in their flora. When still more species became known, Dr. Gray saw that he had to propose a number of genera in order to be consistent, gave the method up, and merged all the species into *Astragalus*. He was followed by Dr. Watson. In the Old World the segregation was begun by Medicus, and continued by Opiz, Fourreau and Steven. The latter proposed not less than 24 new genera. It seems that these should cover all the forms that have been included in *Astragalus*, but this is not the case. In the Old World, the completely 2-celled series is best represented, but in America the 1-celled or incompletely 2-celled forms are predominant. The segregation into several genera was renewed in Dr. Britton's Manual and carried somewhat further in Dr. Small's. The Colorado genera and species may be disposed as follows:

Key to the genera

Leaves pinnate or unifoliolate.
  Pods 2-celled, with a perfect partition.
    Pods fleshy, indehiscent or very tardily dehiscent. — 1. GEOPRUMNON.
    Pods membranous, leathery or woody, dehiscent.
      Pods not inflated.
        Pods ovoid or oblong, rarely almost didymous, terete or flattened vertically, leathery or woody. — 2. ASTRAGALUS.
        Pods linear, more or less flattened laterally, membranous. — 3. HAMOSA.
      Pods strongly inflated, papery. — 4. CYSTIUM.
  Pods 1-celled, the partition, if any, rudimentary.
    Lower suture strongly intruded, making the pod sagittate or obcordate in cross-section; pods membranous, rarely leathery. — 5. TIUM.

Lower suture not intruded or merely slightly so; pods in the latter case woody.
  Pods strongly inflated, papery. 14. PHACA.
  Pods not inflated, or slightly so, membranous to woody.
    Pods with a partial partition, formed by the inflexion of the lower suture.
      Pods membranous. 6. ATELOPHRAGMA.
      Pods woody.
        Pods stipitate; leaves unifoliolate. 7. JONESIELLA.
        Pods sessile; leaves pinnate.
          Calyx-tube short, campanulate, equaling or shorter than the lobes; tall glabrous plants. 8. PHACOPSIS.
          Calyx-tube cylindrical, longer than the lobes; low, cespitose, cinerous or villous plants. 9. XYLOPHACOS.
    Pods without a vestige of a partition.
      Pods not with two grooves on the upper side (or, if slightly grooved, sessile).
        Pods with a fleshy epicarp, in fruit cross-ribbed; leaflets obscurely articulated to the rachis, fleshy, narrow. 10. CTENOPHYLLUM.
        Pods without fleshy epicarp; leaflets distinctly articulated to the rachis.
          Pods woody or at least leathery, flattened or slightly intruded on the lower side.
            Calyx cylindrical; flowers large; plant mostly low and cespitose. 9. XYLOPHACOS.
            Calyx campanulate; flowers small.
              Corolla yellow; calyx-lobes linear-lanceolate, equaling the tube; stipules united; stem low. 12. CNEMIDOPHACOS.
              Corolla purple; calyx-lobes triangular, much shorter than the tube; stipules free or nearly so; stem tall and slender. 11. MICROPHACOS.
          Pods membranous, usually more or less flattened laterally, with both sutures prominent.
            Leaves spinulose-tipped; pods 1–2-seeded. 15. KENTROPHYTA.
            Leaves not spinulose-tipped; pods several- to many-seeded. 16. HOMALOBUS.
      Pods with two grooves on the upper side, stipitate. 13. DIHOLCOS.
Leaves digitately trifoliate. 17. OROPHACA.

1. GEOPRUMNON Rydb.; Small, Fl. SE. U. S. 615. 1903.

Besides by the type, *G. crassicarpum* (Nutt.) Rydb., the genus is represented by:

Geoprumnon succulentum (Richardson) Rydb.
Astragalus succulentus Richardson, Franklin Journey 746. 1823.
Astragalus prunifer Rydb. Mem. N. Y. Bot. Gard. **1**: 239. 1900.

2. ASTRAGALUS L. Sp. Pl. 755. 1753.

As the type, I regard *A. christianus* L., which was an article of food in the desert regions of Syria and the Holy Land. The genus is represented in Colorado by: *A. mollissimus* Torr., *A. Bigelowii* A. Gray, *A. anisus* Jones, *A. canadensis* L., *A. coloradensis* Rydb., *A. nitidus* Dougl. (*A. adsurgens* Hook.; not Pall.), *A. sulphurescens* Rydb., *A. virgultatus* Sheld. and *A. goniatus* Nutt.

3. HAMOSA Medic. Vorles. Churpf. Phys. Ges. **2**: 376. 1787.

The type of this genus was *Astragalus hamosus* L. To it belongs, beside *H. Nuttalliana* (DC.) Rydb. and *H. leptocarpa* (T. & G.) Rydb. already named, also the following:

Hamosa scaposa (A. Gray) Rydb.

Astraglus scaposus A. Gray Proc. Am. Acad. **13**: 366. 1878.

4. CYSTIUM Stev. Bull. Soc. Nat. Mosc. **4**: 268. 1832.

This genus was based on *Astragalus Cicer* L., *A. Pallasii* Sprengel and *A. physodes* L. Congeneric with these are:

Cystium diphysum (A. Gray) Rydb.
Astragalus diphysus A. Gray, Pl. Fendl. 34. 1849.
Cystium ineptum (A. Gray) Rydb.
Astragalus inceptus A. Gray, Proc. Am. Acad. **6**: 525. 1865.

5. TIUM Medic. Vorles. Churpf. Phys. Ges. **2**: 373. 1787.

This was based on *Astragalus sulcatus* L. The typical Colorado species of this genus are:

Tium Drummondii (Dougl.) Rydb.
Astragalus Drummondii Dougl.; Hook. Fl. Bor. Am. **1**: 153. 1831.
Tium racemosum (Pursh) Rydb.
Astragalus racemosus Pursh, Fl. Am. Sept. 740. 1814.
Tium scopulorum (Porter) Rydb.
Astragalus scopulorum Porter, in Porter & Coult. Syn. Fl. Colo. 24. 1874.

I refer to it also the following, which although not closely related to the type fit better in this genus than in any other:

Tium alpinum (L.) Rydb.
Astragalus alpinus L. Sp. Pl. 760. 1753.

Tium sparsiflorum (A. Gray) Rydb.

Astragalus sparsiflorus A. Gray, Proc. Acad. Phila. **1863**: 60, hyponym. 1863. — Proc. Am. Acad. **6**: 205. 1863.

Tium huministratum (A. Gray) Rydb.

Astragalus huministratus A. Gray, Pl. Wright. **2**: 43. 1843.

Tium desperatum (Jones) Rydb.

Astragalus desperatus Jones, Zoe **2**: 243. 1891.

6. **Atelophragma** Rydb. gen. nov.

Caulescent leafy slender herbs with rootstocks. Stipules nearly free both from each other and from the petioles. Leaves pinnate, usually with numerous leaflets. Inflorescence a spike-like raceme. Calyx short, campanulate; lobes slender, subulate. Corolla white or purplish. Pod membranous or papery, more or less compressed laterally, in the typical species decidedly flattened and stipitate; dorsal suture intruding in the pod and forming a partial partition.

The first species below is to be regarded as the type.

Atelophragma aboriginum (Richardson) Rydb.

Astragalus aboriginorum Richardson, Frankl. Journey 746. 1823.

Atelophragma Macounii Rydb.

Astragalus Macounii Rydb. Mem. N. Y. Bot. Gard. **1**: 243. 1900.

Atelophragma glabriuscula (A. Gray) Rydb.

Astragalus glabriusculus A. Gray, Proc. Am. Acad. **6**: 204. 1863.

The following species, although having sessile and more turgid pods, may be included also in the genus:

Atelophragma elegans (Hook.) Rydb.

Phaca elegans Hook. Fl. Bor. Am. **1**: 144. 1831.

Astragalus oroboides americanus A. Gray, Proc. Am. Acad. **6**: 205. 1863.

Atelophragma Brandegei (Porter) Rydb.

Astragalus Brandegei Porter, in Porter & Coult. Syn. Fl. Colo. 24. 1874.

Atelophragma Shearis Rydb.

Astragalus Shearis Rydb. Bull. Torrey Club **31**: 562. 1904.

7. **Jonesiella** Rydb. gen nov.

Stout perennial with a woody root and simple stems. Leaves unifoliolate, thick and veiny; stipules broadly triangular, thin. Racemes 6–8-flowered, axillary. Calyx cylindric, somewhat gibbous, with triangular teeth. Corolla ochroleucous with a purple spot on the keel. Pod stipitate, coriaceous, elliptic, turgid, partially 2-celled by the inflexion of the upper suture.

Jonesiella asclepiadoides (Jones) Rydb.

Astragalus asclepiadoides Jones, Zoe **2**: 238. 1891.

8. **Phacopsis** Rydb. gen. nov.

Stout erect glabrous perennials, more or less branched at the woody base. Leaves pinnate with numerous leaflets; stipules ovate, almost free. Racemes rather many-flowered; flowers nearly sessile; bracts lanceolate. Calyx campanulate; lobes lanceolate-subulate, nearly equaling the tube, at last with spreading tips. Corolla ochroleucous with purple-tipped keel; banner and wings narrow. Pod oblong-ovate, coriaceous, somewhat inflated, with a more or less distinct partial partition formed by the inflexion of the suture.

The first species is to be regarded as the type.

Phacopsis praelongus (Sheld.) Rydb.

Astragalus procerus A. Gray, Proc. Am. Acad. **13**: 369. 1878. Not *A. procerus* Boiss. & Haussk. 1872.

Astragalus praelongus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9**: 23. 1894.

Phacopsis Pattersoni (A. Gray) Rydb.

Astragalus Pattersoni A. Gray in Brandegee, Bull. U. S. Geol. Surv. Terr. **2**: 235. 1876.

Gray, Watson and Sheldon associated *A. Pattersonii* with *A. Fendleri* and *A. Hallii*, but the pod is practically that of *Xylophacos*, *i. e.*, *A. Shortianus* and its allies, but shorter and more inflated. It has a partial partition, although not so prominent as in the preceding. These two species might have been included in *Xylophacos*, but they have a different habit and different calyx.

9. XYLOPHACOS Rydb.; Small, Fl. SE. U. S. 619. 1903.

Besides the type, *X. Shortianus* (Nutt.) Rydb., and *X. missouriensis* (Nutt.) Rydb., the following are found in Colorado:

Xylophacos vespertinus (Sheld.) Rydb.

Astragalus vespertinus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9**: 150. 1894.

Xylophacos amphioxus (A. Gray) Rydb.

Astragalus amphioxus A. Gray, Proc. Am. Acad. **13**: 366. 1878.

Xylophacos uintensis (Jones) Rydb.

Astragalus uintensis Jones, Proc. Calif. Acad. II. **5**: 670. 1895.

Xylophacos pygmaeus (Nutt.) Rydb.

Phaca pygmaea Nutt.; T. & G. Fl. N. Am. **1**: 349. 1838.
Astragalus chamaeluce A. Gray, Bot. Ives' Rep. 10. 1861.
Astragalus Cicadae Jones, Zoe **4**: 35. 1893.

This is somewhat aberrent from the typical species of *Xylophacos*, as its pod is spongy at maturity.

Xylophacos Parryi (A. Gray) Rydb.

Astragalus Parryi A. Gray, Am. Jour. Sci. II. **33**: 409. 1862.

Also somewhat aberrent on account of its long pod inflexed on both sutures, and in this respect approaching the genus *Holcophacos.*

Xylophacos Purshii (Dougl.) Rydb.

Astragalus Purshii Dougl.; Hook. Fl. Bor. Am. **1**: 152. 1831.

Torrey, Gray, Watson and Sheldon placed this species and its allies in the subgenus *Phaca,* while *Astragalus Shortianus* and its closer relatives were placed in *Astragalus* proper. There is only one character to separate the two groups, viz., the long woolly pubescence on the pods in one and the sparse and usually appressed pubescence in the other. Some of the *A. Purshii* relatives have the sutures just as much inflexed as any of the other group. The habit, calyx, etc., are practically the same in both.

Xylophacos Newberryi (A. Gray) Rydb.

Astragalus Newberryi A. Gray, Proc. Am. Acad. **12**: 55. 1876.

Watson placed this in the subgenus *Phaca,* in the same section as *A. Fendleri*, *A. Hallii* and *A. flexuosus.* Scarcely a worse place could have been chosen. The structure of the pod and its pubescence associate it with the preceding and its allies, while the habit is more like a dwarf form of the *A. Shortianus* group.

10. **Ctenophyllum** Rydb. gen. nov.

Stout perennials with often several stems rising from the same root and more or less stoloniferous. Leaves pinnate, with 11–19 linear to filiform leaflets, which are very indistinctly jointed to the rachis; stipules ovate, free from the petioles, but (especially the lower) united back of the stem. Peduncles usually equaling the leaves; raceme short. Calyx cylindro-campanulate, very gibbous at the base on the upper side. Corolla ochroleucous, with narrow petals; keel almost straight. Pod oblong, terete, coriaceous with a subfleshy epicarp, in age cross-wrinkled, with thick and prominent sutures, neither of which is inflexed.

Ctenophyllum pectinatum (Hook.) Rydb.

Phaca pectinata Hook. Fl. Bor. Am. **1**: 141. 1831.

Astragalus pectinatus Dougl.; Hook. *loc. cit.* 142, as a synonym.

11. **Microphacos** Rydb. gen. nov.

Subcinereous perennials with very slender stems. Leaves pinnate with 11–17 linear to oblong leaflets; stipules very broad, triangular, free from the petioles and only the lower more or less united with each other. Racemes many-flowered. Calyx short-campanulate, about 2 mm. long, with very short and broad teeth. Corolla purple, 5–6 mm. long, all petals strongly curved. Pod 6–8 mm. long, coriaceous, cross-wrinkled, wholly 1-celled, 6–7-ovuled, boat-shaped, *i. e.*, lower suture prominent, strongly curved, upper suture nearly straight or curved upwards, flat or slightly sulcate.

The first species is to be regarded as the type.

Microphacos gracilis (Nutt.) Rydb.

Astragalus gracilis Nutt. Gen. **2**: 100. 1818.

Microphacos microlobus (A. Gray) Rydb.

Astragalus microlobus A. Gray, Proc. Am. Acad. **6**: 203. 1863.

12. **Cnemidophacos** Rydb. gen. nov.

Cespitose perennials with a woody caudex; stems short, 1 2 dm. high. Leaves pinnate with many narrow leaflets, cinereous; stipules slightly united with the petioles, but almost wholly united behind the stem forming a sheath. Racemes strict and many-flowered. Calyx deeply campanulate; lobes linear-lanceolate, equaling the tube. Corolla yellow, with narrow petals. Pod coriaceous, oblong-ovoid, rounded below, somewhat depressed above, but with a very sharp suture and hence somewhat 2-grooved.

Cnemidophacos flavus (Nutt.) Rydb.

Astragalus flavus Nutt. in T. & G. Fl. N. Am. **1**: 335. 1838.

Tragacantha flaviflora Kuntze, Rev. Gen. Pl. **2**: 941. 1891.

Astragalus flaviflorus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9**: 158. 1894.

This has been placed in the *Eu-Astragalus* division, next after *A. racemosus*, and in a section together with *A. luministratus* and *A. oreganus*, to which it has no relationship. The only similarity is the conspicuousness of the stipules.

13. **Diholcos** Rydb. gen. nov.

Stout erect perennials often forming clumps. Leaves pinnate with many thick leaflets; stipules lanceolate, free. Raceme many-flowered, dense, spike-like; bracts lance-subulate. Calyx campanulate, gibbous at the base on the upper side; teeth subulate-setaceous. Corolla purple, white or ochroleucous; petals only moderately curved and blunt. Pod coriaceous, stipitate, oblong, straight, rounded on the lower suture, deeply 2-grooved above and with a prominent upper suture, 1-celled.

The first species is to be regarded as the type.

Diholcos bisulcatus (Hook.) Rydb.

Phaca bisulcata Hook. Fl. Bor. Am. **1**: 145. 1831.

Astragalus bisulcatus A. Gray, Pac. R. R. Rep. **12**: 42. 1860.

Diholcos decalvans (Gandoger) Rydb.

Astragalus bisulcatus decalvans Gandoger, Bull. Soc. Bot. France **48**: xv. 1902.

Diholcos Haydenianus (A. Gray) Rydb.

Astragalus Haydenianus A. Gray in Brandegee, Bull. U. S. Geol. Surv. Terr. **2**: 235. 1876.

14. PHACA L. Sp. Pl. 755. 1753.

The Colorado species are as follows: *Phaca longifolia* (Pursh) Nutt., *P. picta* A. Gray, *P. Candolleana* H. B. K., *P. pauciflora* Nutt., and:

Phaca Eastwoodiae (Jones) Rydb.

Astragalus Preussii sulcatus Jones, Zoe **4**: 37. 1893.

Astragalus Eastwoodiae Jones, Zoe **4**: 368. 1894.

Phaca artipes (A. Gray) Rydb.

Astragalus artipes A. Gray, Proc. Am. Acad. **13**: 370. 1878.

Phaca cerussata (Sheld.) Rydb.

Astragalus cerussatus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9** : 139. 1894.

Phaca Bodinii (Sheld.) Rydb.

Astragalus Bodinii Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9** : 122. 1894.

Sheldon placed this among the *Homalobi* and described the pod as being flat, but all specimens with well-developed fruit show that the species is a typical *Phaca.*

Phaca humillima (A. Gray) Rydb.

Astragalus humillimus A. Gray, in Brandegee, Bull. U. S. Geol. Surv. Terr. **2** : 235. 1876.

Phaca elatiocarpa (Sheld.) Rydb.

Astragalus lotiflorus brachypus A. Gray, Proc. Am. Acad. **6** : 209. 1863.

Astragalus elatiocarpus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9** : 20. 1894.

Phaca Wetherillii (Jones) Rydb.

Astragalus Wetherillii Jones, Zoe **4** : 34. 1893.

15. KENTROPHYTA Nutt. in T. & G. Fl. N. Am. **1** : 353. 1838.

Besides the *K. viridis* Nutt., the following are found in Colorado :

Kentrophyta impensa (Sheld.) Rydb.

Astragalus Kentrophyta elatus S. Wats. Bot. King's Expl. 77. 1871. Not *A. elatus* Boiss. & Bal. 1849.

Astragalus viridis impensus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9** : 118. 1894.

Kentrophyta Wolfii Rydb.

Homalotus Wolfii Rydb. Bull. Torrey Club **31** : 562. 1904.

Kentrophyta aculeata (A. Nelson) Rydb.

Astragalus tegetarius implexus Canby, in Porter & Coult Colo. Add. (no page-number) 1874.

Astragalus aculeatus A. Nelson, Bull. Torrey Club **26** : 10. 1899.

16. HOMALOBUS Nutt. in T. & G. Fl. N. Am. 1: 350. 1838.

The following are the Colorado species: *H. caespitosus* Nutt., *H. wingatanus* (S. Wats.) Rydb.; *H. Clementis* Rydb., *H. tenellus* (Pursh) Britton, *H. campestris* Nutt., *H. decurrens* Rydb., *H. hylophilus* Rydb., *H. tenuifolius* Nutt. and *H. decumbens* Nutt. Also:

Homalobus grallator (S. Wats.) Rydb.

Astragalus grallator S. Wats. Zoe **3**: 52. 1892.

Homalobus acerbus (Sheld.) Rydb.

Astragalus acerbus Sheld. Bull. Geol. & Nat. Hist. Surv. Minn. **9**: 123. 1894.

Homalobus junciformis (A. Nelson) Rydb.

Astragalus junciformis A. Nelson, Bull. Torrey Club **26**: 9. 1899.

Homalobus camporum Rydb. sp. nov.

A cespitose perennial; stems erect, 1–2 dm. high, grayish-strigose; leaves 3–5 cm. long; leaflets 9–15, linear to nearly filiform, rarely oblong, 4–10 mm. long, 0.5–2 mm. wide, silvery-canescent; stipules ovate, somewhat scarious, strigose; raceme 5–10 cm. long; flowers 7–15; bracts subulate; calyx campanulate, white-silky, about 3 mm. long; lobes lance-subulate, about ⅔ as long as the tube; banner about 6 mm. long, white or ochroleucous with purple veins; keel with a narrow purple tip; pod linear, 12–18 mm. long, 2–3 mm. wide, compressed, straight, strigose.

This is rather common on the plains and hills from Alberta to Colorado and Utah and has been known as *Astragalus campestris*, *A. decumbens* and *A. tenuifolius* Nutt. The first of these is a taller plant 3–4 dm. high, more simple; its pod is 2–2.5 cm. long and its keel is broad and blunt. *H. decumbens* has an arcuate pod and in *H. tenuifolius* the calyx-teeth are triangular and only ¼–⅓ as long as the tube. As the type may be assigned:

WYOMING: Bush Ranch, Sweetwater Co., June 10, 1900, *Aven Nelson 7085*.

Homalobus flexuosus (Hook.) Rydb.

Phaca flexuosa Hook. Fl. Bor. Am. **1**: 141. 1831.

Astragalus flexuosus Dougl.; Hook. *loc. cit.*, as a synonym.

This and the following differ from the typical species of *Homalobus* in having almost terete instead of flattened pods. The pods are, however, of the same texture, wholly one-celled and with prominent sutures, and the plants are of the same general habit.

Homalobus Hallii (A. Gray) Rydb.

Astragalus Hallii A. Gray, Proc. Am. Acad. **6**: 224. 1863.

Homalobus Fendleri (A. Gray) Rydb.

Astragalus Fendleri A. Gray, Pl. Wright. **2**: 44. 1853.

Homalobus proximus Rydb. sp. nov.

Cespitose perennial, related to *H. flexuosus*; stems erect, 2–3 dm. high, grayish-strigose; leaves 4–6 cm. long; stipules triangular-ovate, glabrous; leaflets 5–11, linear or linear-oblong, obtuse, 5–11 mm. long, 1–2 mm. wide, grayish-strigose; racemes erect, 5–10 cm. long; calyx about 2.5 mm. long, strigose; corolla 4–5 mm. long, white or ochroleucous; pod oblong-linear, terete, glabrous, about 12 mm. long and 3 mm. in diameter, glabrous, acute at the apex, abruptly contracted into a short stipe about equaling the calyx.

COLORADO: Arboles, June, 1899, *C. F. Baker 421.*

Homalobus Salidae Rydb. sp. nov.

Decumbent or ascending perennial; stem 3 dm. or more long; leaves 5–7 cm. long; stipules triangular-ovate, strigose; leaflets 15–21, oblong-oblanceolate to narrowly linear, 8–15 mm. long, 0.5–3 mm. wide, strigose; racemes 10–15 cm. long, lax; pedicels 5 mm. long; bracts minute; calyx campanulate, strigose and slightly black-hairy, about 3 mm. long; teeth short, triangular; corolla about 8 mm. long, purple-veined; pod narrowly linear-oblanceolate, terete or nearly so, 2–2.5 cm. long, 2 mm. in diameter, finely strigose, very acute at the apex and gradually tapering into a short stipe below.

COLORADO: Salida, August 3, 1896, *C. L. Shear 3468.*

Homalobus macrocarpus (A. Gray) Rydb.

Phaca macrocarpa A. Gray, Pl. Fendl. 36. 1849.

Astragalus lonchocarpus Torr. Pac. R. R. Rep. **4**: 80. 1856.

This species is doubtfully referred to *Homalobus*. It may represent a monotypic genus of its own. The relationship is however much closer to *Homalobus* than to *Phaca*, with which it has been associated.

17. OROPHACA (T. & G.) Britton, Man. 555. 1901.

Besides *O. sericea* (Nutt.) Britton, the following are found in Colorado:

Orophaca tridactylica (A. Gray) Rydb.

Astragalus tridactylicus A. Gray, Proc. Am. Acad. **6**: 527. 1866.

Orophaca aretioides (Jones) Rydb.

Astragalus sericoleucus aretioides Jones, Cont. West. Bot. **8**: 13. 1898.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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Alexander, S. Some interesting Michigan plants; possibly some new species. Ann. Rep. Mich. Acad. Sci. **6**: 88, 89. 1904.

Arthur, J. C. Revised list of Indiana plant rusts. Proc. Ind. Acad. Sci. **1903**: 141–152. 1904.

Beal, W. J. A few words concerning the new Michigan Flora. Ann. Rep. Mich. Acad. Sci. **6**: 90, 91. 1904.

Beal, W. J. How I know some of our trees in winter. Ann. Rep. Mich. Acad. Sci. **5**: 237, 238. 1904.

Blankinship, J. W. A century of botanical exploration in Montana, 1805–1905: collectors, herbaria and bibliography. Montana Agric. Coll. Sci. Stud. Bot. **1**: 3–31. 1 N 1904.

Bogue, E. E. The lichen genus *Physcia*. Ann. Rep. Mich. Acad. Sci. **5**: 170, 171. 1904.

Bray, W. L. Forest resources of Texas. U. S. Dept. Agr. Forestry Bull. **47**: 1–71. *pl. 1–8* + *f. 1, 2*. 1904.

Bray, W. L. The timber of the Edwards Plateau of Texas: its relation to climate, water supply and soil. U. S. Dept. Agr. Forestry Bull. **49**: 1–30. *pl. 1–5*. 1904.

Burns, G. P. Formation of peat in Dead Lake. Ann. Rep. Mich. Acad. Sci. **5**: 76, 77. 1904. [Illust.]

Chase, H. H. Flora michiganensis: *Algae: Diatomaceae:* a list of Michigan *Diatomaceae.* Ann. Rep. Mich. Acad. Sci. **5**: 166–169. 1904.

Chodat, R. & Hassler, E. Plantae Hasslerianae soit énumération des plantes récoltées au Paraguay. Bull. Herb. Boissier II. **5**: 65–90. 31 D 1904.

Includes new species in *Ionidium, Oxalis, Adenocalymna, Anemopaegma, Mansoa, Macfadyena, Tecoma* and *Abutilon.*

Christ, H. Primitiae florae costaricensis. *Filices* et *Lycopodiaceae* III. Bull. Herb. Boissier II. **5**: 1–16. 31 D 1904. [Illust.]

Includes new species in *Polypodium* (7), *Elaphoglossum* (2), *Antrophyum* (2) and *Gleichenia* (4).

Clark, A. W. Regeneration of the epicotyl in seedlings of *Vicia Faba* and *Pisum sativum.* Ann. Rep. Mich. Acad. Sci. **6**: 80. 1904.

Conzatti, C. Los géneros vegetales Mexicanos. **1**: 197–395. Mexico, 1904.

Cook, O. F. Food plants of ancient America. Rep. Smiths. Inst. **1903**: 481–497. 1904.

Cratty, R. I. Some interesting grasses of northwestern Iowa. Iowa Nat. **1**: 3–6. Au 1904.

Dandeno, J. B. The question of water-absorption by foliage leaves. Ann. Rep. Mich. Acad. Sci. **5**: 213. 1904.

Dandeno, J. B. The relation of mass action and physical affinity to toxicity, with incidental discussion as to how far electrolytic dissociation may be involved. Am. Jour. Sci. IV. **17**: 437–458. Je 1904.

Davis, C. A. Rough-barked and smooth-barked white oaks. Ann. Rep. Mich. Acad. Sci. **6**: 82, 83. 1904.

Dorner, H. B. Additions to the flora of Indiana. Proc. Ind. Acad. Sci. **1903**: 117, 118. 1904.

Elrod, M. N. Botanical Notes. Proc. Ind. Acad. Sci. **1903**: 119–128. 1904.

Farwell, O. A. Contributions to the botany of Michigan. No. 8. Ann. Rep. Mich. Acad. Sci. **6**: 200–214. 1904.

Fenno, F. E. Supplementary list of plants of the Susquehanna valley. N. Y. State Mus. Bull. 75: 57–60. 1904.

Fitzpatrick, T. J. The June flora of the Ocheyedan mound. Iowa Nat. **1**: 6–10. Au 1904.

Focke, W. O. *Oenothera ammophila.* Abh. Nat. Verein Bremen **18**: 182–186. N 1904.

Foxworthy, F. W. Discoid pith in woody plants. Proc. Ind. Acad. Sci. **1903**: 191–194. *f. 1–4.* 1904.

Gallardo, A. Maíz clorántico. Anal. Mus. Nac. Buenos Aires III. **4**: 315–327. *f. 1–4.* 26 S 1904.

Greene, E. L. Affinities of the *Cichoriaceae.* Leaflets **1**: 59–63. 25 Au 1904.

Greene, E. L. Certain polygonaceous genera. Leaflets **1**: 17–32. 5 Ja 1904; 33–48. 12 Mr 1904; 49, 50. 25 Au 1904.

Includes descriptions of new species in *Bistorta* (6) and *Persicaria* (41), and one new genus, *Duravia* (S. Wats.).

Greene, E. L. Certain West Indian *Cruciferae.* Leaflets **1**: 81–88. 21 D 1904; 89, 90. 31 D 1904.

With 5 new genera and 7 new species.

Greene, E. L. The genus *Pneumonanthe.* Leaflets **1**: 68–71. 24 N 1904.

Greene, E. L. *Laothoe.* Leaflets **1**: 90, 91. 31 D 1904.

Greene, E. L. The Neckerian cactaceous genera. Leaflets **1**: 50–53. 25 Au 1904.

Greene, E. L. New plants from middle California. Leaflets **1**: 73–80. 24 N 1904; 81. 21 D 1904.

New species in *Lupinus* (4), *Lotus*, *Sidalcea* (2), *Silene*, *Aquilegia*, *Delphinium*, *Bistorta*, *Eriogonum*, *Swertia*, *Castilleia* (2), *Pentstemon*, *Apocynum*, *Cryptanthe*, *Galium*, *Chrysothamnus* (2), and *Macronema.*

Greene, E. L. New species of *Ceanothus.* Leaflets **1**: 65–68. 24 N 1904.

Descriptions of 5 new species.

Greene, E. L. North American species of *Amarella.* Leaflets **1**: 53–56. 25 Au 1904.

With descriptions of 8 new species.

Greene, E. L. On certain *Gentianaceae.* Leaflets **1**: 91–95. 31 D 1904.

New species are described in *Swertia* and *Aloitis.*

Greene, E. L. A rare *Swertia.* Leaflets **1**: 72. 24 N 1904.

Greene, E. L. Seven new apocynums. Leaflets **1**: 56–59. 25 Au 1904.

Descriptions of 7 new species in *Apocynum.*

Greene, E. L. Some western buckthorns. Leaflets **1**: 63, 64. 25 Au 1904; 65. 24 N 1904.

Descriptions of 5 new species in *Rhamnus.*

Greene, E. L. Two new *Batrachia.* Leaflets **1**: 95, 96. 31 D 1904.

Huber, J. Notas sobre a patria e distribução geographica das arvores fructiferas do Pará. Bol. Mus. Goeldi **4**: 375–406. D 1904.

Huber, J. A origem da Pupunha [*Guilielma* sp.]. Bol. Mus. Goeldi **4**: 474–476. D 1904.

Huber, J. Qual deve ser o nome scientifico do nosso Assahy [*Euterpe* sp.]? Bol. Mus. Goeldi **4**: 477, 478. D 1904.

Huber, J. Sobre os generos *Vouacapoua, Vatairea* e *Andira.* Bol. Mus. Goeldi **4**: 469–471. D 1904.

Huber, J. Sobre as ilhas fluctuantes do Amazonas. Bol. Mus. Goeldi **4**: 480, 481. D 1904.

Loew, F. The importance of plant variation and its bearing upon the evolution of species. Ann. Rep. Mich. Acad. Sci. **6**: 84–87. 1904.

Macloskie, G. Flora patagonica: flowering plants. Rep. Princeton Univ. Exped. Patagonia **8**: 139–338. *pl. 12–14 + f. 27–61.* 25 Je 1904.

Mainini, C. La *Vallesia glabra* (Cav.) Link, vulgarmente llamada Ancoche: estudio botánico, químico y farmacodinámico de su alcalóide la vallesina. 1–172. *f. 1–51.* La Plata, 1904.

Mottier, D. M. The development of the spermatozoid of *Chara.* Proc. Ind. Acad. Sci. **1903**: 137. 1904.

Mottier, D. M. Further studies on anomalous dicotyledonous plants. Proc. Ind. Acad. Sci. **1903**: 139. 1904.

Murr, J. Additamenta ad genus *Chenopodium.* Magyar Bot. Lap. **3**: 37–39. *pl. 1.* 5 Ap 1904.

Includes descriptions of *C. querciforme* sp. nov. and *C. Quinoe orbicans* var. nov., both from Brazil.

Peck, C. H. Report of the State Botanist, 1903. N. Y. State Mus. Bull. 75: 1–68, *pl. O, 84–86.* 1904.

New species are described in *Entoloma, Hebeloma, Hypomyces, Hydnum* (2), *Inocybe* (5), *Lactarius, Stereum* and *Tricholoma.*

Pierson, A. W. The occurrence of *Basisporium gallarum* Molliard in Michigan. Ann. Rep. Mich. Acad. Sci. **6**: 81. 1904.

Plowman, A. B. Electrotropism of roots (preliminary communication). Am. Jour. Sci. IV. **18**: 145, 146. Au 1904.

Plowman, A. B. Electrotropism of roots. Am. Jour. Sci. IV. **18**: 228–236. *pl. 9, 10.* S 1904.

Rehm, H. Beiträge zur Pilzflora von Südamerika XIV. Hedwigia **44**: 1–13. 29 O 1904.

Includes descriptions of 32 new species in 28 genera; of the genera 2 are new.

Röll, J. Beiträge zur Torfmoosflora des Cascadengebirgen in Nord-Amerika. Hedwigia **44**: 46–48. 29 O 1904.

Schnarf, K. Beiträge zur Kenntnis des Sporangienwandbaues der *Polypodiaceae* und der *Cyatheaceae* und seiner systematischen Bedeutung. Sitz.-Ber. Akad. Wiss. Wien, Math.-Nat. Classe **113**: 549–573. *pl.* 1904.

Schneider, C. K. Die Gattung *Berberis* (*Euberberis*). Vorarbeiten für eine Monographie. Bull. Herb. Boissier II. **5**: 33–48. 31 D 1904.

Smith, C. P. Notes upon some little known members of the Indiana flora. Proc. Ind. Acad. Sci. **1903**: 133–135. 1904.

Stephani, F. *Hepaticarum* species novæ X. Hedwigia **44**: 14, 15. 29 O 1904.

Includes *Scapania Geppii* sp. nov., from Dominica.

Stuckert, T. Contribución al conocimiento de las Gramináceas Argentinas. Anal. Mus. Nac. Buenos Aires III. **4**: 43–161. 16 Au 1904.

New species are described (all by Hackel) in *Paspalum*, *Setaria*, *Aristida*, *Stipa*, and *Melica* (2).

Tilton, G. H. An addition to the fern flora of Vermont. Rhodora **6**: 235, 236. 16 D 1904.

Ward, L. F. A famous fossil cycad. Am. Jour. Sci. IV. **18**: 40–52. Jl 1904. [Illust.]

Cycadoidea Reichenbachiana (Göpp.) Cap. & Solms.

Warner, L. A. The regeneration of seedling roots after splitting. Ann. Rep. Mich. Acad. Sci. **6**: 78. 1904.

White, D. The seeds of *Aneimites*. Smiths. Misc. Coll. **47**: 322–331. *pl. 47, 48.* 10 D 1904.

With a description of *A. fertilis* sp. nov.

Wieland, G. R. The proembryo of the *Bennettiteae*. Am. Jour. Sci. IV. **18**: 445–447. *pl. 20.* D 1904.

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Vol. 2, No. 3; not furnished separately:

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Vol. 2, No. 4; price, 75 cents:

Wheelock, W. E. The genus *Polygala* in North America. Pages 109–132. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, J. K. & Heller, A. A. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol. 3, No. 2; price, $2.00:

Morong, T. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

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